THE AMERICAN GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME LXIII.—No. 20. Whole No. 1,066. | NEW YORK, MONDAY, NOVEMBER 11, 1895 | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS. H. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 32 Pine Street, New York.

Terms of Subscription, Including Postage—For the United States and Canada, $3 per annum. European countries, $4.50 (19 shillings—22½ francs). All payments to be made in advance. Single copies, 10 cents.

Remittances should be made either by post office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICE—
November Meeting, Society of Gas Lighting..... 769

EDITORIALS—
Briefly Told..... 769
Mr. Goodwin's Lecture on Acetylene—Notes.

Abstract of Proceedings, Twenty-third Annual Meeting of the American Gas Light Association—Continued from page 740..... 770
First Day, Afternoon Session—Committee on Next Place of Meeting—*Lecture on Acetylene, by Mr. W. W. Goodwin—Discussion—Second Day—Morning Session—*Notes on the Storage of Oil at Gas Works, by Mr. Frederic Egner—Discussion—Bench Firing with Soft Coal, by Mr. E. G. Pratt—Discussion.

Technical Analysis of Asphalts, by S. P. Sadtler, Ph.D..... 779

ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 780
Mr. Lansden in New Offices—Consolidation at Oroville, Cal.—Franchise Granted, Muskegon, Mich.—Contract for the Berlin Iron Bridge Company—Mr. Harms Has Valuable Grants—Something from Mr. Boardman—Mt. Clemens, Mich., to Have Gas—The Actual Population of Barre, Vt.—The Memphis Gas Ordinance—Cheaper Gas for Zanesville, Ohio—Death of Mr. Geo. F. Colby—The Troy (N. Y.) Company's Assessment Revised—A Hint from Charlestown, Mass.—Death of S. R. Smith, of Wilkes-Barre—Control of the Minneapolis (Minn.) Company in New Hands—Annual Meeting, Toronto, Can.—Death of Mr. S. H. Condict—and Many Other Items.

Asbestos for Pipe Covering..... 782

The Market for Gas Securities..... 782

[OFFICIAL NOTICE.]

November Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, November 1, 1895.

The November meeting of the Society of Gas Lighting will be held in the works of the Mutual Gas Light Company, New York City, at 3 P.M. of Thursday, the 14th inst. FRED. S. BENSON, Secretary.

BRIEFLY TOLD.

MR. GOODWIN'S LECTURE ON ACETYLENE.—An interesting feature of the Philadelphia meeting of the American Gas Light Association was the lecture delivered by Mr. William Wallace Goodwin, whose subject was acetylene. The veteran's remarks will be found reported in full elsewhere in the JOURNAL; and no matter what else may be said about them, it is a fact that the lecture brought to an interesting close the proceedings of the first day. The lecturer illustrated the chapters of his story by means of practical experiments, which, though neither mysterious nor complex, were none the less illustrative, since, as they were practical, they were easily understood. Perhaps the time and place of the lecture were singularly appropriate, for Philadelphia had been quite worked up to the point of expecting great things from the evolution of acetylene through the decomposition of calcic carbide, because a Company to exploit those things had had no difficulty in putting out capital stock there; in fact, the Company could have obtained subscribers in number sufficient to take up at least thrice the capital that it proposed to issue. However, whether the date of the Goodwin lecture was propituous and well-timed is a matter of small moment compared with the fact as to whether the lecture was to point to a new fund of knowledge respecting the subject thereof. A close reading of Mr. Goodwin's presentation of his subject fails to disclose anything of moment that is new in connection with calcic carbide and acetylene, although it is beyond doubt that his story shows a comprehensive study of the subjects as they stood up to the time of his lecture. The main point, though, for gas men to consider is just now as it was in mid-October—whether a pure article of the carbide can be put on the market at anything like a price that would enable them to use it as an ally; or whether it can be put on the market at a price that need cause them fear of it in the shape of a competitor? The chief reference in the Goodwin lecture to the latter part of the above query is found in this paragraph of our report of his remarks: "In my Springfield paper I stated that the price at which carbide of calcium had been proposed to be sold was at the rate of $100 per ton, and in small quantities it was about $800. Since that time I have secured reliable data which would seem to demonstrate it can be produced at a cost of manufacture of $20 per ton. I have had access to actual cost figures, and, as examined by me, I think I am safe in saying this is a liberal estimate." No doubt, Mr. Goodwin's figure of $20 per ton was obtained from a source that would be concerned principally in putting the manufacturing charge for the material at the cheapest possible rate; and under such circumstances it is natural to infer that the estimators would, in their desire to cause the best thing for themselves to be the most apparent, be influenced by enthusiasm, if not anything else. In that reflected light, let us look to what seems to be to us the actual state of the case. When the promoters of the acetylene industry in this country first called the attention of the public to their "discovery," the statement was boldly made that calcium carbide, as a result of electrolytic manufacture, could be manufactured for $12, or less, per short ton. Later on the cost estimate was increased to $15, and now it is virtually admitted that the cost to the maker is $20. At the last figure *pure* calcic carbide would undoubtedly be an important factor in the gas industry—either as an ally or as a competitor; but, our best information obtained not from guess work, nor from a desire to belittle its value, still shows that Mr. Bredel's figure (*vide*, JOURNAL, Feb. 25, 1895) of $40 per ton of 2,000 pounds, is very close to the true mark. Further, if anything, that Mr. Bredel errs on the low rather than the high side. In this connection, too, we wish here to say that those of the gentlemen interested in the evolution of the calcium carbide industry in this country, who charge that the JOURNAL is prejudiced and unfair in its utterances on this subject, are well out of their reckoning. Our only interest or contention in the matter is that the truth of the case shall be known. We have neither shares in any acety-

lene company for sale, nor any fear that acetylene gas can in any sense interfere with the prosperity of the gas industry as a whole. Indeed, the President of the Association put (in the discussion that followed Mr. Goodwin's lecture) his opinion just as we hold ours, when he said that gas men had nothing to fear from acetylene gas, since, if the carbide could be brought out at a price sufficiently low to enable gas makers to use it profitably as an enricher, the gas makers would be the first to take hold of it for such use. And as far as the share part of our disclaimer; well, if anyone can trace a dollar's worth of such interest, let nim at once tell all he knows about it. After looking through Mr. Goodwin's presentation of his subject it will also be noticed that the veteran does not give himself up unreservedly to the championing of the acetylene cause, as witness this excerpt from his lecture: "I have made these special allusions to the facts and dates, as history is being rapidly made in this matter, and I have no hesitation in saying and putting myself on record as prophesying that no discovery in the gas world * * is destined to fill as important a place on the profit side of the account as this discovery, if all that is claimed for it be true." There we are in entire accord with Mr. Goodwin. If perfect carbide of calcium can be put upon the market for $20 per ton of 2,000 pounds, it is a good thing; and, of course, at any price thereunder, a still better thing. Meanwile, that it can be sold at the present time at a profit to its makers at anything under Mr. Bredel's estimate, we do not believe.

NOTES.—Mr. James Long, who had been with the Troy (N. Y.) Gas Company for 30 years, died at his home in that city on the 1st inst.——Director Thompson, of the Philadelphia City Gas Bureau, says that the increase in the gas output in Philadelphia, for the nine months ended October 31, 1895, as compared with the corresponding period for 1894, amounted to 275,000,000 cubic feet.——Mr. D. T. Roots, President of the P. H. & F. M. Roots Company, of Connersville, Ind., writing under date of October 31st, says: "We are pleased to say that for the past year our business has been exceptionally good in all its departments, and in our gas exhauster division we think we have done considerably more than in any year since we have been in business. Our prospects for the ensuing year are very bright, and it looks that with the revival in general trade we will have more than we can do. We are already running up to 10 o'clock at night, and believe we will be compelled to put on a force to run the entire 24 hours. We are also enlarging our foundry to double its present size and intend to equip it with travelling cranes, etc., in order to make it a thoroughly modern shop. Below are some of our principal sales and orders received in the past few months: Laclede Gas Light Company, St. Louis, Mo., two No. 8 exhausters and engines; combined capacity, 500,000 cubic feet per day. Western Gas Construction Company, Fort Wayne, Ind., No. 5 exhauster; capacity, 600,000 cubic feet per day. Burlington (Ia.) Electric Lighting Company, one No. 6 exhauster and engine; capacity, 980,000 cubic feet per day. Terre Haute (Ind.) Gas Company, one No. 6 exhauster and engine; capacity, 980,000 cubic feet per day. Kentucky Heating Company, Louisville, Ky., one No. 8 exhauster and engine; capacity, 2,500,000 cubic feet per day; also one blower and engine. Universal Gas Company, Chicago, three No. 6 exhausters and engines; combined capacity, 7,500,000 cubic feet per day. Clinton (Ia.) Gas Company, one exhauster and engine; capacity, 400,000 cubic feet per day. Missouri Gas Company, Kansas City, Mo., one No. 7 exhauster and engine; capacity, 1,400,000 cubic feet per day. Marietta (O.) Gas Company, one No. 3 exhauster and engine; capacity, 215,000 cubic feet per day. Cooke & Co. (Agents), New York, two No. 1 exhausters and one No. 4 exhauster and engine; combined capacity, 550,000 cubic feet per day. Kerr Murray Mfg. Co., Fort Wayne, Ind., one No. 2 exhauster and engine; capacity, 115,000 cubic feet per day. Hamilton (O.) Gas Light Company, one No. 3 exhauster; capacity, 215,000 cubic feet per day. L. M. Rumsey Mfg. Co., St. Louis, Mo., one No. 1 exhauster and engine; capacity, 72,000 cubic feet per day. Gas Engineering Co., Pittsburgh, Pa., one No. 3 exhauster and engine; capacity, 215,000 cubic feet per day. Paris (Ky.) Gas Company, one No. 1 exhauster; capacity, 72,000 cubic feet per day. City Gas Company, London, Canada, one No. 2 exhauster and one No. 4 exhauster; combined capacity, 515,000 cubic feet per day. Cedar Rapids (Ia.) Gas Company, one No. 4 exhauster; capacity, 400,000 cubic feet per day. Kansas City (Mo.) Gas Company, one No. 6 exhauster and engine; capacity, 980,000 cubic feet per day. For pumping natural gas we have also furnished one No. 10 and two No. 2 exhausters; combined capacity, 6,000,000 cubic feet per day. Also one No. 10 exhauster for special work, to work at a pressure of 5 pounds per square inch; capacity, 5,500,000 cubic feet per day. We also have orders for two No. 10 and two No. 8 exhausters, each with engine and bedplate; combined capacity, 16,000,000 cubic feet per day."

[Continued from page 740.]

ABSTRACT OF PROCEEDINGS, TWENTY-THIRD ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION.

HELD AT CONTINENTAL HOTEL, PHILA., PA., OCT. 16, 17 AND 18, 1895.

FIRST DAY—AFTERNOON SESSION.

The discussion on the paper by Mr. Humphreys having been closed, on motion of Captain White a vote of thanks was passed to the author. The President then announced the appointment of the Committee on Place of Next Meeting (Messrs. Chollar, Gartley, Forstall, Littlehales and C. J. R. Humphreys) and introduced Mr. W. W. Goodwin, of Philadelphia, who delivered the following lecture on

ACETYLENE.

Mr. President and Members of the American Gas Light Association:

At the annual meeting, last March, of the Ohio Gas Light Association, held at Springfield, it was my privilege to read a paper[1] upon carbide of calcium and the gas resulting from its decomposition, viz., acetylene. In that paper I gave a history of how I had become acquainted with Mr. Willson's important discovery and my efforts to devise some form of apparatus to properly consume the gas. I also alluded to Prof. Vivian B. Lewes' paper[2], read before the Society of Arts, at a meeting held in London, January 16th, 1895. I also stated the fact that it had been my privilege to witness the first effort of consuming the gas in a flat-flame burner in this country without mixture with air. At the meeting I also exhibited the burning of the gas in the same manner, and illustrated my remarks with a few experiments, all of which were set forth in the published report of the meeting. I also alluded to the fact that not a pound of carbide could be had in New York at any price, notwithstanding an article which had appeared in the New York papers a few days before stating that a proposition would soon be made to furnish consumers the gas at the rate of seven cents per thousand. Notwithstanding the fact I had failed to secure a pound of the carbide at any price, and that when any had been sold it was at the rate of $100 per ton, in concluding my paper I said, "I have refrained from touching upon the commercial value of the carbide as an illuminant, as I prefer to leave that portion of the subject to others, my principal object being to place on record a little history, and to afford an opportunity to the Society to witness a few experiments that I thought, in view of the prominence the subject had been given, might prove of interest."

On my return to Philadelphia I found that Dr. J. J. Suckert and Mr. T. L. Willson, the patentee, had visited this city and read a paper accompanied with experiments before the Franklin Institute. This paper was read on the evening of the day I had read the one alluded too. I had no idea of their intention to present their paper to the Institute, nor they of my effort in the same direction.

Prof. Lewes, prior to his paper of January 16th, on the discovery of Mr. Willson to produce carbide in the electrical furnace, had read an exceedingly interesting and original paper[3] before the Chemical Society, at its meeting in London, in 1892—this was quite two or more years before Mr. Willson's discovery. In this paper he showed quite conclusively that the illuminating power of the gas flame depended largely upon the quantity of acetylene present. When in London three years ago, he presented me with a copy of the paper, which, read in the light of the discovery of the easy means of producing acetylene and adding it to the gas flame, is certainly remarkable, and reflects great credit upon Prof. Lewes' knowledge, ability and research as a chemist and scientist; for hardly had he called attention to the importance and value of the presence of acetylene in the gas flame as an illuminant, when Mr. Willson made the important discovery of how readily carbide of calcium could be produced in an electrical furnace and from which acetylene can also be easily produced. I have made these special allusions to the facts and dates, as history is being rapidly made in this matter, and I have no hesitation in saying and putting myself on record as prophesying that no discovery in the gas world of late years has been of as much importance or has caused as much anxiety, and I feel is destined to fill as important a place on the profit side of the account as this discovery, if all that is claimed for it be true.

In my Springfield paper I was unable to give information which is now at my command. Since then I have made numerous tests and experiments, and have been able to verify a number of the figures given in the papers of Prof. Lewes, and Messrs. Suckert and Willson,

1. See JOURNAL, April 1, 1895, p. 449.
2. See JOURNAL, February 4, 1895, p. 147.
3. See JOURNAL, May 23d, 1892, p. 759.

and as far as made I have found no variation, and have no reason to anticipate any such result.

I will now endeavor to briefly enumerate some of these facts, after which, with the assistance of Mr. Hewes, my son, Mr. Stout and others, I will endeavor to illustrate and demonstrate the accuracy of the same as far as the limited time at my command will permit, and then leave you to judge and decide for yourselves as to whether I have good grounds for my prophesy.

Acetylene has long been known to the scientific world. Among the first to discover the ability to produce carbides through the agency of high temperatures was Sir Humphrey Davy, followed by Berzelius, about 1836. In 1862 Wöhler succeeded in making calcium carbide in a small way by fusing an alloy of zinc and calcium with carbon, which he found would decompose by contact with water forming calcic hydrate and acetylene. Others succeeded in producing the gas in various ways, but all on a small scale and as laboratory experiments, none of which gave any commercial promise, as the acetylene produced by these methods was too expensive. It remained for Mr. Willson to make the discovery how carbide of calcium could be produced in large quantities and cheaply, compared with the methods already alluded to. While working with an electric furnace and endeavoring to form an alloy of calcium from some of its compounds, he found that a mixture composed of lime and powdered coke subjected to the temperature of the arc in his furnace, fused these substances and produced a heavy semi-metallic mass, which upon examination not proving to be the substance sought, he threw some of the material produced into a bucket of water near at hand, and noticed a rapid and violent ebullition of the water and evolution of gas, accompanied with a strong odor which attracted his attention. Upon the application of a light to the escaping gas a smoky and luminous flame was produced. From this discovery he commenced a series of experiments, and it was while engaged in this direction that he visited the New York office of the company of the speaker, which resulted in the investigation he has been more or less engaged in for over a year.

I will now describe the apparatus, give data and make some experiments as proposed. This rough sketch [indicating] will give an idea of the form of furnace used by Mr. Willson, consisting of a carbon or graphite crucible placed upon an iron plate to which a wire was connected and led to the terminal brushes of a dynamo. Within the crucible is seen a carbon bar or pencil which was also connected to a wire leading to the dynamo. To give a better idea of the apparatus used to operate this furnace and manufacture the carbide, I will quote from a report of Mr. Vincent, M. E., and Mr. Hewes, E. E., from a test they made at Spray, N. C. They state: "The plant consisted of one twin Leffel turbine wheel, 30 inches in diameter, making 206 revolutions, at 28 feet head, developing 300 horse power at ¾ gate opening. This turbine is belted direct by tandem belts to two Thomson-Houston alternating current dynamos run in parallel. These dynamos are separately excited by two standard exciters for a 120 kilowatt machine and are run from the out-board pulley by tandem belts to one dynamo. The dynamos each are 120 kilowatt capacity, generating 1,155 volts at full load at a speed of 1,070 per minute, with 125 alternations per second. The primary wires are connected in multiple to 16 Thomson-Houston transformers of 15,000 watts capacity, each of type four pattern. The primary windings have a range of from 52 to 104 volts, according to the voltage on the primary, and have 60 cycles per second. The secondary windings are connected in parallel to the two furnaces by means of eight wire cables, respectively attached to the anode and cathode of each furnace, making 16 cables to the two cathodes, and 16 cables to the anodes. The cables consist respectively of 123 wires, No. B. & S. gauge, spirally wound, and ¼-inch in diameter. The anode consists of six 4 x 4 carbons, 36 inches long. These carbons are held in the carbon holder in a group, making the complete carbon 96 square inches in cross section. After running seven consecutive times of an average of four hours each these carbons were decreased in length by one-half inch. The cathode was composed of an iron plate, two inches in thickness, on which is superimposed a layer of carbon 12 inches thick an electrical connection to which is made by fusing eight of the above cables. The carbon pencil is fed by hand by means of a screw and threaded iron wheel attached by chain and pulleys to the stem of the carbon holder, which is raised or lowered by the attendant according as the current varies."

The averages of the tests covering observations were made each 15 minutes, and for several hours, and extended over three days. The average for the first day was 64.5 volts and 1,561.7 amperes. The second day the average (readings taken as on first day) was 64.4 volts and 1,981 amperes. The third day readings, as per first and second days, were 64.3 volts and 1,984 amperes. This data will enable those of you who are familiar with applications of the units employed by electricians to determine for yourselves the electric energy developed in these tests. The report gives the horse power developed as 125, 166 and 157.7 actual horse power used, and the quantities of mixture operated upon respectively, 1,142, 1,246 and 982 pounds. These figures will give you an idea of the size of machinery that has been used in the tests and quantity of material used.

Now a word as to the proportions of the composition of the material used. Experiments have demonstrated that 87½ pounds of lime and 56½ pounds of carbon will produce 100 pounds of carbide of calcium and 43¾ pounds of carbon monoxide; and 100 pounds of carbide of calcium, with 56½ pounds of water, will produce 115.62 pounds of slacked lime and 40.62 pounds acetylene. The carbon monoxide is equal to 18¾ pounds of carbon and 25 pounds of oxygen. This formula will give you some idea of the chemical reaction.

The material produced is not inflammable and can be exposed to the temperature of a blast furnace without melting. Mr. Stout will now please try the effect of a blowpipe on a piece of the carbide. You see it has no effect upon it, but the moment it is brought into contact with water or its vapor, gas is generated, as will be seen by Mr. Hewes holding a corner of a piece in the water. He will now drop a piece into the beaker containing water. You see the gas rapidly rising to the top of the surface. Now he will apply a light and you will note the result. Each pound of carbide will generate over 5½ cubic feet per pound, or exactly 5.892 of acetylene gas having a temperature of 64° F. It also may be decomposed by exposure to snow at a temperature of —24° F. The gas is colorless, but makes its presence known by a garlicky odor. It is soluble in water equal to the volume of the latter, and can readily be condensed to a liquid at a temperature of 67.27° F.—it requires a pressure of 39.76 atmospheres (say 40), or 600 pounds per square inch.

The gas in this condition forms a colorless and mobile liquid which, as the pressure is slightly relieved, commences to boil and evolve gas which, upon ignition, burns with an intense white flame, but if suddenly liberated would instantly solidify and form into snow at a temperature of —118° F.; and yet at this low temperature it possesses the same illuminating power as at the high temperature. One pound of the liquid, when evaporated at 64° F., will produce 14½ cubic feet at atmospheric pressure, or a volume equal to 400 times that of the liquid. The gas can be cooled to —100° F., or heated to 600° F. above, without impairing its illuminating power.

I have here a piece of apparatus (see Fig. A) designed by me over a year ago, which will show you quite plainly the generating of the gas and which will enable collecting same and consuming it through a burner. The apparatus consists of a cylindrical glass jar, within which is inserted a glass tube, surmounted with a cap, cock and burner. Within the tube there is a small metallic basket supported by a wire from the cap. Mr. Stout having placed in the basket a few pieces of broken carbide, we will insert the tube within the jar—the air within the same, surrounding the basket, will prevent the water from reaching the carbide. We will now open the cock which will allow the air to escape through the burner. The water will at once ascend, and the moment the water touches the carbide decomposition will commence to take place. Acetylene gas will be the result, which is manifested by the bubbles that will be seen surrounding the basket, and which, ascending the tube, will expel the air, and in a moment the gas will have reached the burner, as will be seen when we apply a light. The result is before you.

I think I can claim that this piece of apparatus is the simplest form that can be used for exhibiting the production and burning of the gas.

I have here a small pneumatic gasholder (see Fig. B) which will hold just 1 cubic foot of gas between the upper and lower marks. The area of the holder is equal to 1 square foot, or 144 inches. The scale is divided into 12 inches, so that I am able to measure exactly 1,728 cubic inches, or 1 cubic foot. Each inch on the scale being subdivided into four parts enables a reading of 36 cubic inches. This holder is now full of water. Alongside you see an apparatus (see Fig. C), designed by me some months ago. It consists of a piece of 2-inch tube, properly capped, and an arrangement for admitting water, which is permitted to flow down upon the top of the carbide. The moment the water touches the carbide, as you saw a moment ago, gas is evolved, and unless permitted to escape an enormous pressure is produced. As long as any carbide remains in the scoop and water can reach it the evolution of gas continues and the pressure continues to increase, and if sufficient material were present to be acted upon, the pressure would become sufficient to rend the tube asunder if not sufficiently strong to resist the pressure.

I found that it was also necessary to design some method that would

enable the introduction of water against the pressure. This was accomplished by an arrangement of a tube which compensates the pressure and enables me to introduce the necessary water, no matter what the pressure. The small gauge you see is to indicate the pressure within the tube.

With this explanation, we will proceed to make some gas and fill our holder. Mr. Stout will now remove the cap which enables us to withdraw the scoop, and we will now fill it with some small pieces of the carbide. Having done so, we will insert the scoop and replace the cap; this done, we will fill the small tank with water; this done, we will open the cock to the gauge, which you see stands at zero, and we will now open the compensating cock to enable the water to flow into the tube and on the top of the carbide in the scoop. All being ready, we will proceed to set our gas works into operation, for this is what this whole apparatus means. Now, please fix your eyes upon the gauge and watch the effect the instant the water touches the carbide. I will now open the cock and allow the water to flow into the tube. As you saw, the effect was to instantly cause the hand of the gauge to start; there is now a pressure of 20 pounds per square inch in the tube; and before proceeding further we will allow the gas that is within the tube (and that has caused this pressure) to pass into the holder. You see the effect was to displace a volume of water equal to the volume of gas that has passed into the holder. By examining the scale we find the quantity that was confined equaled about 400 cubic inches. We will now allow more water to enter the tube and pass the gas direct to the holder, which you see is taking place by the rapid displacement of the water. To convince you that our gas works have worked successfully, if that be necessary, we will light a burner. Had our apparatus been arranged to condense the gas while under pressure, it would have become liquefied. This would have required a cooling attachment; and anyone placing his hand on this tube would be prompted to remove it at once, as the temperature produced by the apparatus is very high. We have, however, a cylinder which contains the liquid acetylene, having been prepared in the manner stated. Before going further I will say the specific gravity of carbide of calcium from which the liquid gas was made is 2.263, when pure. Acetylene is a heavy gas, with a specific gravity of 0.91.

This steel cylinder before you (see Fig. D.) contains the liquid gas under a pressure of 40 atmospheres, or 600 pounds, per square inch of surface. Mr. Hewes will please relieve some of the gas, and by the governor at the bottom we will be able to reduce the pressure when it reaches the burners to 2½ inches water pressure. The result you will see enables the pure gas to be consumed without smoking, the burners consuming at the rate of one-half a cubic foot per hour, and giving a light equal to 25 standard sperm candles consuming 120 grains per hour.

We will now pass some of the gas through these coils, one of which will be subjected to the heat of a Bunsen burner assisted by a blast of air. In order to raise the temperature promptly, the arrangement of the coil (see Fig. E.) will permit you to observe the illuminating power of the gas before entering the coil, also after being subjected to the intense heat of the coil as it passes out of the burner at the other end. The other coil (see Fig. F.), similar in its construction, is surrounded with finely powdered ice and salt to assist in reduction of temperature. As I have stated, this arrangement permits you to observe the illuminating power before being subjected to these changes of temperature and thereafter. This test demonstrates the statement made a few moments ago regarding heat and cold.

Another question naturally arises as to what is the effect on ordinary gas when brought in contact with it; and will it mix; and, if so, will it increase its candle power? My answer is in the affirmative. I will now proceed to prove this assertion. I have made a number of tests in that direction and have also succeeded in devising a means that enables the making of a thorough mixture and perfectly controllable. I have a small model here and will proceed to show the effect of the mixture. The pipe before you (see Fig. G.) contains the mixing device, and is surmounted by several burners. Mr. Stout will now please turn on the ordinary city gas and light the burners. You have before you six burners consuming regular gas. Mr. Hewes will now permit the liquid gas from the cylinder *D* to pass through the governor into the inlet of the pipe. The acetylene is now ready to be introduced into the mixing device. Mr. Stout will now allow it to enter and mix. You will see the result immediately by the instant increase of the illuminating power of the burner by reason of the mixture. We will now turn off the regular gas and note the effect of attempting to consume the acetylene pure through the burners at the end. You see from the amount of carbon unconsumed and set free that it would be impossible to attempt to consume acetylene through the ordinary gas burners, unless mixed with air or gas to reduce it. We will now turn on the city gas; you see the result is as before, a mixture that can be consumed.

I now propose to show by means of the same apparatus that a pure acetylene can be consumed through the same system of pipes, by simply substituting burners properly adapted to consume acetylene. These burners are on the same line of pipe and are those that were lighted in the previous test, but gave comparatively no light. We will now shut off the city gas and allow the pure acetylene to be consumed through the other burners, which *are* adapted to consume the gas without smoking, as has already been shown you in the previous test, my special object being, as stated, to show you that the same pipes and fixtures require no changes, *save* in the burners. These burners, as in the other experiment, consume about ½ cubic foot per hour. We will now turn off the acetylene and substitute the city gas. You see it is utterly impossible to do justice to the city gas, for the same reason as in the attempt to consume acetylene through burners adapted for city gas. In this case honors seem to be easy, with this difference, however. We can get results from the city gas by again introducing acetylene, which we will now do. Mr. Stout will turn on the acetylene; the result is before you.

Much has been said about the explosive properties of this gas, and I confess I was inclined to think it contained serious elements of danger. It has also been said that a shock conveyed to the liquid gas was liable to produce such a result. You see this tube. I have dropped it upon the floor, thereby endangering your lives as well as my own if it contains the liquid gas, if the assertion were true. Well, it did not go off; and you and I still live. Perhaps it was because there was nothing in the tube. Mr. Hewes will kindly favor us with an examination to settle that question. It seems there *was* liquid acetylene gas within the tube; therefore, I think this disposes of that question. But it is explosive when mixed with a sufficient quantity of atmospheric air, as I will now show you. I have here two eudiometer tubes (see Fig. H), graduated into 100 parts. It will be but the work of a moment to introduce the proper proportions of air and acetylene, which my son will proceed to do. The proportions for this test will be 1.25 times its own volume of air—this mixture begins to be slightly explosive. We have here a small coil and battery, and will, in a moment, have the connections adjusted to pass a spark through the eudiometer between the two platinum points that are just beneath the glass stopcock. All being in readiness, the spark will be passed. Watch the effect, for it should be instantaneous, everything being in order. All ready? Go! You no doubt saw the flash caused by the explosion. We could go on in this manner to show the point at which it is most explosive by increasing the amount of air until it amounted to about 12 times its volume of air, when the maximum would be reached, and would gradually diminish in violence, until the proportions stood 20 of air to 1 volume of acetylene, when it would cease to be explosive. The fact that acetylene is explosive when mixed with the proper valume of air seems to me should settle the question of the inadvisability of attempting to consume it in that manner, particularly when it is susceptible to demonstration that a low grade of gas can be made, down to 8 to 12-candle power, which can be increased to at least 20 candles by proper mixture of acetylene. I offer the suggestion for your consideration in anticipation of the question arising. Another question that arises is as to its contaminating effect upon the atmosphere in its consumption in comparison with the consumption of ordinary gas.

Prof. Lewes in his paper presented a comparative table which may be summed up as follows: A 5-foot burner consuming ordinary gas will produce an amount of carbon dioxide and watery vapor that would amount to the exhalations of about 18 adults, whereas that of acetylene would equal a little over 3 adults.

In my Springfield paper I stated that the price at which carbide of calcium had been proposed to be sold was at the rate of $100 per ton, and in small quantities it was about $800. Since that time I have secured reliable data, which would seem to demonstrate it can be produced at a cost of manufacture of $20 per ton. I have had access to actual cost figures, and, as examined by me, I think I am safe in saying this is a liberal estimate.

Now, a word more and I am done. While not intending to discuss its commercial value, as I think I have presented experiments and figures enough to set you to thinking and determine the question for yourselves, I will offer the following suggestion for your consideration, a solution of which will help to determine the other questions. As 1 ton of 2,000 pounds of carbide of calcium will produce about 11,000 cubic feet of acetylene gas capable of supplying 22,000 ½-foot burners, each of which will give a light equal to 25 standard sperm candles for one

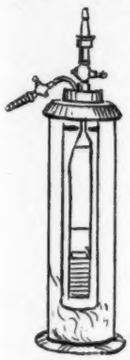


Fig. A.

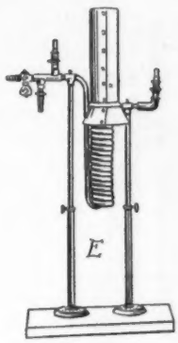


Fig. E.

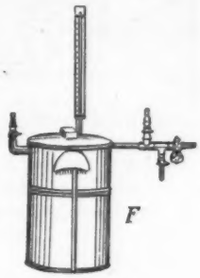


Fig. F.

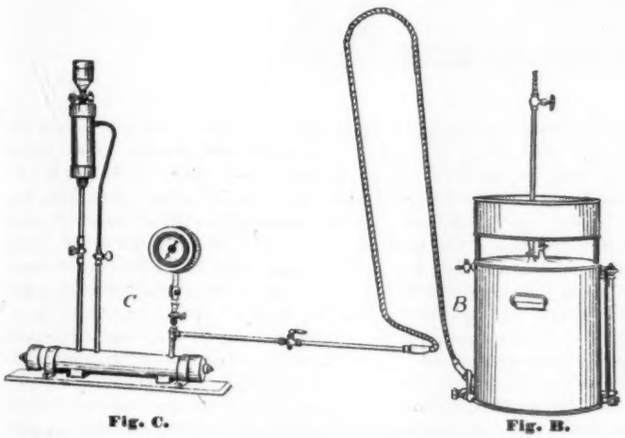


Fig. C. Fig. B.

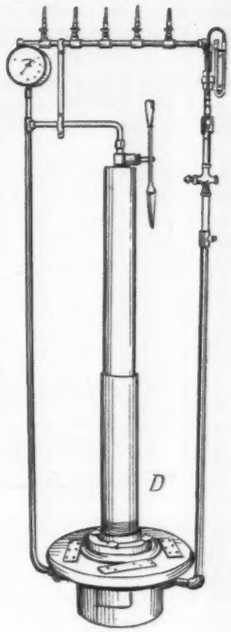


Fig. D.

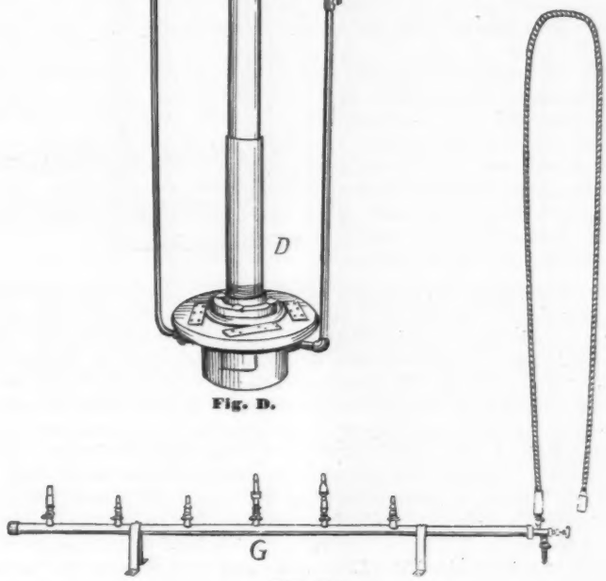


Fig. G.

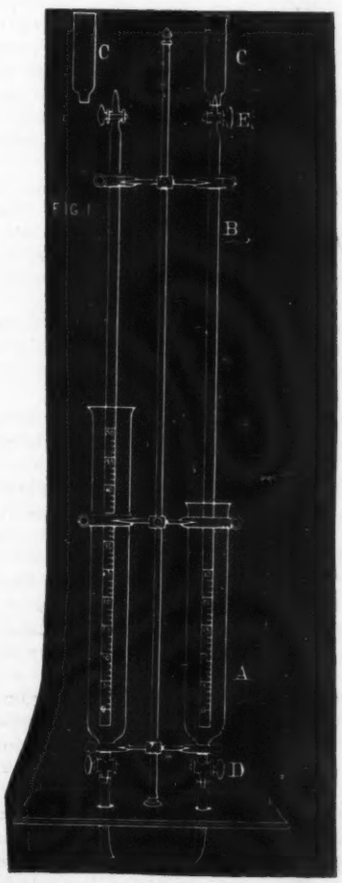


Fig. H.

hour, or an aggregate of 550,000 standard sperm candles, compare this with the number of 5-foot burners that the gas from 1 ton of coal will supply for the same time, then aggregate the total candle power of same, a calculation which you can all make and which I omit for reasons. So if the carbide can be produced for the price named, I think you have sufficient food for reflection, and you can also decide whether I had sufficient grounds for the prophetic assertion I made at the commencement of this paper. There are other portions of the subject I have not attempted to touch or refer to, as the time allotted would not permit and I fear I have already taxed your patience, and I thank you for the kind attention and indulgence you have extended to me. I again thank you for the same.

Discussion.

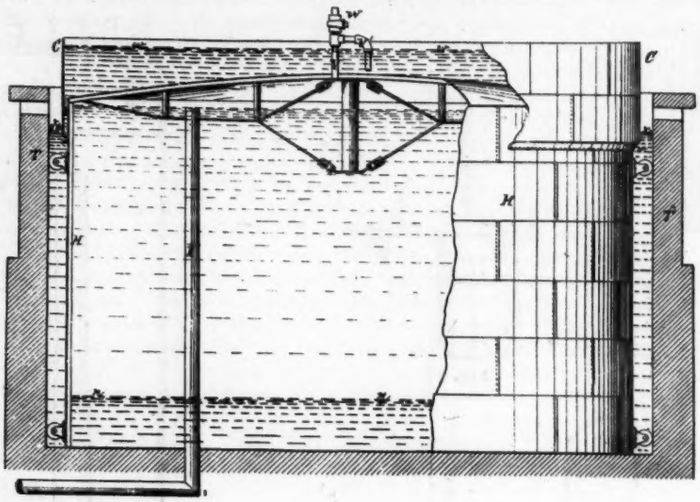
Mr. Goodwin's lecture, which took up perhaps an hour of time, was listened to with close attention, and the lecturer was frequently applauded. The illustration experiments were quite successful. In the discussion that followed, and which was participated in by the President and Messrs. Littlehales, Nettleton, Somerville, Egner, Goodwin, Adam Weber and others, noteworthy statements were those by the President and Mr. Weber. The former said gas men had nothing to fear from acetylene gas, for if the carbide could be manufactured at a low price the gas companies would be the first to employ it as an enricher; and the latter (Mr. Weber) said he had witnessed the development of acetylene gas this year in Germany, and uttered the conviction that it would, within a few years, be in actual use, in one way or another, as an illuminant, wherever artificial light was used. On motion of Mr. Littlehales a vote of thanks was passed to Mr. Goodwin, and the sessions were adjourned to the morning of the following day.

SECOND DAY—MORNING SESSION.

The second day's sessions were opened at 10 A.M., Thursday, October 17th. The President called upon Mr. Frederic Egner, of Norfolk, Va., who read the following

NOTES ON THE STORAGE OF OIL AT GAS WORKS.

From the published proceedings of the latest meeting of one of the principal Gas Associations of our country, it appears that certain points of interest in the storage of oil at gas works are still not sufficiently well defined to satisfy engineering requirements, which demand *facts*, not *opinions*. To supply some of these is the object of this paper.



Before doing so, however, a recapitulation of things of past interest to gas makers in the storage of oil, since its earliest practical application to our industry, may be useful now. Let it be understood that reference is made only to tanks used for storing petroleum or its products used in gas making. In giving you this bit of "Ancient History," the writer hopes to be excused, for it may be seen as we go along, on reflection, that even a knowledge of the past, carries with it lessons of practical utility for the present; and the whole is submitted without further comment. Thirty years ago oil tanks were sometimes constructed of wood, because, as some believed, and a certain Mr. Jacob Reese, of Pittsburg, expressed it, "Wooden vessels are the cheapest and the best;" but because (so Mr. Reese continues) "It has been found impossible to make wooden tanks that will not leak—that even the best oak barrels have to be lined with glue to prevent the escape of the oil," he therefore designed a rectangular wooden tank with a water jacket around it, and this, with a little water poured into the bottom of the tank before filling with oil, was stated to absolutely prevent any waste. This design was intended for holding oil at the wells in its crude state, and refined oil at the refineries in large quantities. That was in the infancy of the modern oil business.

About that time, H. P. Gengembre, of Tarentum, Pa., invented what seems to have been a decided improvement in the method of storing oil, at least as applied to gas works, had they at that date used the article to any extent. The improvement is described as a tank "made like a gas holder, having tight sides, but open at the bottom," placed in a reservoir of water, so that, as the oil flows into the tank, it will, owing to its being of less specific gravity, displace a corresponding weight of water, which will escape through the bottom of the tank, and through a suitable overflow provided in the cistern. Suitable inlet and outlet pipes for the oil are also shown in the patent drawings. Altogether it was a good idea, and the precursor of the very good and more practicable oil tank for gas works, designed later on by our gifted and lamented Past-President, Theobald Forstall.

About one year after Gengembre, S. H. Ingalls describes an improvement of his, which, while embodying the essential features of the former, makes a specialty of keeping the top of the oil always in contact with top of the tank, by means of water pressure (the tank being fastened to the bottom of the cistern, so that it could not rise.) The object of this arrangement is stated to be "thereby to prevent all possibility of accumulation of gases or vapors and all danger of fire or explosion therefrom." The heating coil of steam pipe for the bottom of an oil tank was patented in 1865, and is stated to have for its object "the prevention of accumulations of solid deposits on the floor of an hermetically sealed metal tank." An entirely submerged tank made of iron, and glass gauges on the outside, to show the contents, are described but not "claimed" as inventions, about that time.

These devices were shown in a number of designs for oil tanks of more than a quarter of a century ago, when also the water-covered top was first shown by Joshua K. Ingalls, of New York city. Bizard and Labarre, of Marsailles. France, designed, in 1867, an oil tank, which they also describe was to be constructed "like a gasometer." It is very like the one of Gengembre, only that it is intended to be kept entirely under water, or to have a water-covered top. To assure safety from fires, one genius proposed in effect, that when one wanted an oil tank, to build two; one with its bottom a little higher than the top of the other. The oil was to be kept in the upper one, always, except when that took fire, when all one had to do, was to open a valve, and the oil would run off into the lower tank and thus be saved. This idea was enlarged upon subsequently, so that the object could be obtained automatically when a fire took place. There were imitators of all these ideas, who mostly obtained patents upon some slight improvement or other, but as none of these have any bearing upon tanks as used at gas works, they will be consequently "by-passed" in this paper.

The dangerous nature of the vapors arising from oil tanks received its due share of attention. Hinged and counterbalanced manhole covers, to permit the ready discharge of vapors and insure rapid closing of same after such discharge; wire gauze-filled openings, and many other devices to make the discharge of vapors less dangerous, and prevent firing back in case of chance ignition, were proposed; and some suggested that the only safety to oil tanks lay in thoroughly ventilating the space between cover and oil, *and to burn the products some distance away from the tanks* (?) The concussion caused by a severe flash of lightning was asserted to be sufficient to cause explosions in oil tanks, also discharges of static electricity generated by conditions inherent to the oil and tank were mentioned, and means to prevent these alleged dangers were patented; but it would be profitless to discuss these things.

June 27, 1871, a patent was granted to Mr. Theobald Forstall, then of New Orleans, La. This is shown in the annexed illustration, taken from the patent specifications, and it seems so plain and simple, that a description may be dispensed with. A modified form of this invention was used by the writer at one time. There were short guide frames not shown in the drawing, but not the water top which is shown. The holder would rise or fall slightly as vapors would be formed, and on the whole it seemed to be a very good tank, indeed, and most any tight gasholder, which might be too small now, and out of date, could be used in that way.

One of the curiosities in tank construction, patented during the year 1886, consists in supporting the whole tank, at its outer edge only, upon a heavy wall, and arching the bottom (of the metal tank) in such a way that any portion of it can be reached for inspection when desired. Modifications of the same construction have been patented, yet, as it appears to be an expensive method, it seems one not likely to meet with much favor. A novel idea was that of the late Joseph Flannery, who, compelled by necessity because of lack of room, designed his oil tank as part of the water space of the water tank of his relief holder, and, from experience, the writer can say that it was a most convenient and absolutely safe arrangement; still, if the room could be had, the plan of Mr. Forstall would be more favored by the author—that is to say, for oil tanks required at large works, when often several hundred thousand gallons must be stored. Where much less oil is used, my practice has been to prefer the vertical cylinder form of tank, with glass gauges arranged somewhat like the water gauges of a steam boiler, by means of which the contents of the tank may at any time be inspected. The top of the tank is connected with the inlet of a gasholder, by means of a pipe of suitable size, and the tank is thus always under a slight pressure, and safe. This method of connecting the top of an oil tank with a gasholder has been my practice since 1872 or 1873, when it was done (if I

mistake not) by direction of the late I. Herzog, then Chief Engineer of the Metropolitan Gas Light Company, of New York city, whose assistant the writer was at the time. Time and experience proved that method a good one, and it was therefore a great surprise to see it questioned in the course of a discussion published in our technical journals during the past months of May and June. Hence, to satisfy himself once more upon the subject, the writer engaged in a series of experiments during the past summer, and the results obtained are herewith presented to you.

We have three oil tanks, two of the vertical and one of the horizontal cylinder pattern, with an aggregate capacity of 50,000 gallons. The horizontal cylinder is under cover; the two vertical tanks are located in an open pit, and subjected to all atmospheric influences. They have been connected and supplied with gauges in the manner above indicated, but measurements may also be taken by inserting a measuring rod through the tops of these tanks, and both methods were employed during my experiments. We use gas naphtha, ranging from 72° to 76° specific gravity by Beaume's hydrometer, at 60° F. Four observations were taken each 24 hours, for 31 days, during which time the thermometer ranged from 62° at night to 118° in the sun, though the latter temperature was reached but once.

Our tanks are arranged in such a way that we can cut out any one from the others, and this was done with one of them, which at the beginning of the trial we found to contain 14,845 gallons. After 31 days, during which no oil had been put into or taken from this tank, it was found that there was absolutely no loss by reason of evaporation, or any other cause for that matter. The tank is about 15 feet in diameter and 12 feet high. The bottom, of No. 10 iron, rests on yellow pine sills with air spaces 15 inches wide between them. The side (of No. 12 iron) and top (of No. 10 iron) are painted white. The bottom sheets are riveted with ⅞-inch rivets, spaced 1¼ inches between centers, the sides and top with ¼-inch rivets, spaced 1 inch between centers. The sheets are iron to iron, with no packing between, but the tanks were filled with water before being filled with oil.

As previously stated, these tanks are entirely unprotected from the weather. The oil would expand .57 per cent, of its bulk, under a difference of 30° in temperature of the atmosphere. The temperature of the oil was not taken, hence these last figures signify little. The significant fact is that there was no loss from evaporation, under the varying conditions, all that time. And that accords well with the statements of some of the earlier experts in oil storage, who, away back in 1865, observed that when oil was stored under a slight pressure the tendency for the evolution of vapors was greatly diminished, and who proposed to always store oil, even at the wells, that way (under a slight pressure), and supplied tanks with a light pressure safety valve, set so it would open before the pressure within the tank would become too great for its safety.

In our case the pressure was equal to 3 inches to 5 inches of water, and my practice always was to provide oil tanks not only with a light pressure safety, but also a light resistance vacuum valve, to guard against all contingencies should anything happen to go wrong with the vent pipe to the holder. During the experiment mentioned the gas vent pipe was connected in a suitable manner with two gas meters, light check valves being placed before the inlet to each meter. The meters were so arranged that vapors might pass out of the tank in one and gas into it in another direction. It was expected that the diaphragms in the vapor meter would not last long, but we hoped they would stand a few days at least, and give us an idea of the volume of vapors passing. None passed, and the vapor meter, after examination, proving all right, is now doing duty at some consumer's place.

But the gas meter found a leak for us in the oil tank, first thing, which we stopped, with the result already given. After all this was done we cut the gas off from the oil tank, and venting into the open air, lost .127 per cent. of the oil inside of 24 hours, which trial we pursued no further, but speedily reconnected our vent pipe in the old tried manner, *which we know is "O. K."*

Discussion.

Mr. A. C. Humphreys disagreed with Mr. Egner's statement that naphtha when exposed to the atmosphere and sun, and in a temperature ranging as high as 118° F., will not vaporize if there is 5 inches of pressure; for in his own experience naphtha had vaporized under just such conditions.

Mr. Newell said that at the New Brunswick gas works the oil tanks are placed below the surface, and are protected from the direct rays of the sun. The gas works were about 60 feet lower than the railroad depot, and this permitted the delivery of oil through a pipe line to the bottom of the tanks. The oil being delivered by gravity they were able to empty a car, and without using a pump, in about 40 minutes. The tanks are so connected with one another by shut-offs that any one, or all, of the tanks can be drawn from at any time. The stock of oil on hand can be readily ascertained by removing the manhole cap and measuring the depth. The bottom of each tank is graded to a corner, so that in case of accident the overflow of oil can be turned into the sewer.

Mr. Thompson had tried the experiment of putting tanks under ground, and the result had not been very satisfactory. During a severe rain storm the water had lifted the tanks clean out of the ground and broke all the connections. Since that time he had built a brick wall around the sewer connection to prevent the recurrence of such an accident.

Mr. Gartley had adopted the plan of allowing the gas to collect on top of the oil in the tanks, instead of the air; and had not noticed any change in candle power due to the flow of the vapor. The tanks are 40 feet in diameter, and hold 180,000 gallons; they have a water cap top, and are situated on the other side of the generating house from the holder. A light is placed on the 6-inch main connecting oil tanks and holder, and by that light he was able to detect any vapor flowing through the pipe. Some naphtha vapor is found at that point, showing that there is some evaporation taking place, even though the pressure suggested by Mr. Egner is maintained.

Mr. Thompson inquired the best means of connecting steam pipe with the tank for the purpose of warming heavy oils.

Mr. Smith replied that he had adopted the plan of running a cross pipe from the blower engine, parallel to the suction pipe, to the oil tanks. He had warmed crude oil in that way for the purpose of pumping it.

Mr. Pinkney said that in Utica, where the temperature at times was down to 40° below zero, they sometimes had considerable difficulty in pumping the oil, and he had adopted the plan of running a steam pipe parallel with the suction pipe, and wrapping them both together with a non-conductor, and found the results entirely satisfactory.

The President then introduced Mr. E. G. Pratt, of Des Moines, Ia., who read the following paper, entitled

BENCH FIRING WITH SOFT COAL.

This is not a new subject, neither is the subject matter which follows, inasmuch as a portion of it formed part of a report contributed to the meeting of another Association by the writer nearly two years ago.

Ordinarily I would not have consented to the revamping of this report, in order to present it to this Association, but for the reason that the Secretary of this Association has had the promise from me for a paper during the year now closing, and also because continued experience in the use of soft coal for furnace purposes at intervals during the past two years has furnished information which I did not possess, but rather assumed, at the time the report referred to was prepared.

To those familiar with the trials and tribulations I have experienced of late, the above preliminary excuse would be unnecessary, but to those who are not, I will simply say that I have been otherwise engaged in matters not as agreeable as the preparation of a paper for the good of this Association.

The idea of using coal as a substitute for coke (for it can be nothing more than a substitute) would hardly suggest itself to anyone engaged in the manufacture of coal gas, except there were circumstances and conditions that would recommend it, and these would unquestionably be low price of coal, high price of coke, and a reasonably good demand for the latter.

Such were the conditions surrounding our situation which first prompted the writer to consider the substitution of coal for coke; and in the renewal of benches from time to time during the past four years we have endeavored to construct a setting that would show us the best results when using coal for fuel. This seemed to be easy enough in the minds of the manufacturers of firebrick and retort goods, and it is true their statements received good backing from places using their particular bench with coal as fuel; but whether unsatisfactory results in our early experiences were due to a poor quality of fuel, an inferior grade of gas coal, or insufficient and unintelligent attention on the part of workmen, I was at the outset unable definitely to determine, and am now disposed to assign to each in equal proportions that which is left, after allowing to the bench as much of the responsibility as is justly due it.

As it was a "condition and not a theory which confronted us," I desire to explain a little more in detail what is meant to be inferred by the above paragraph. It is well known that the grade of coal mined in

Iowa is not of the best; in fact, I believe it is inferior to that produced in most of the other coal producing regions of this country, although its cost at the mines is quite as great as that of the better grades found elsewhere.

While not prepared to make comparison by analyses, I am of the opinion that a bench constructed to burn slack in one locality would not thrive as well on slack with us. In other words, that, to obtain as good results, it would be necessary for us to use a better grade of coal, and by better grade, I mean coal that had been screened to the size of, say, chestnut or nut.

As regards gas coal, we have had difficulty in the past in getting a constant supply of a superior quality of that. Whether this is due to our location or not, I am unable to say, although I am certain that we did not, during a period of two years, have delivered to us such coal as the writer has had experience with before and since. This seems strange, too, as the shippers have been reputable concerns, and their coal is reported as being mined in that region from which the best gas coals are produced.

It would be an easy matter to dismiss the difficulties encountered at this point, but I am unwilling to pass over the other obstacle to the successful use of coal for fuel without reference to what is meant by "insufficient and unintelligent attention" on the part of workmen. That a bench fired with coal requires more attention than if coke is used, there can be no question; and that with frequent necessary changes in the quality of fuel used, that careful and intelligent attention is necessary, is equally true.

With a coke fire it is important only to secure the right adjustment of the air ports and dampers to obtain, with judicious firing, good combustion; while with changeable grades of coal as fuel, it is necessary to alter these conditions to conform to the kind and quality of fuel used. Good results cannot be accomplished here except there is an earnest desire on the part of workmen to accomplish something more than the condemnation of coal for bench firing; and herein lies the greatest difficulty, for, of course, the bringing in of coal, more frequent firing, cleaning of fires oftener, the unusually large quantity of clinker to be removed from furnaces, means increased labor to the stoker, which he naturally shrinks from. All these things are to be considered as possible reasons why coal firing may not be successful. These obstacles do not appeal to the minds the builder, however, nor should they, if he has planned and constructed a bench that is correct in the details for which it was intended.

At our works during the past six years we have built three different sets of benches, in which our design was to use coal for fuel.

The first was three benches of 6's, built in 1889; the second three benches of 6's, in 1890, and along side the first three, differing from each other only in the additional depth of 12 inches given to the furnaces of the last three constructed, and both were styled half-depth or semi-regenerative benches. Their construction did not differ materially from the ordinary coke bench, except in the arrangemet of the flues and organ pipes, so-called, for the proper conduct of the air and gases into the combustion chamber.

The principle of this bench was correct, I believe, but its construction was weak and hardly able to withstand the severe strain to which it was subjected when coal was used for fuel, particularly the arrangement of the upright flues or organ pipes, which were too few in number and not of sufficient strength. As a result any change of temperature in the bench usually resulted in one or more of these organ pipes being broken, besides being very easily choked with unconsumed carbon. I understand that a more recent construction of this bench has remedied the difficulty, both as to strength and increased number of organ pipes, and that at St. Louis, where a modified and improved form of this bench was put in, it was, at last accounts, being operated with coal firing with very satisfactory results; although upon a recent visit to St. Louis, I do not remember seeing this type of bench in use, but rather as a substitute one of simple construction from which excellent results were being obtained.

Our benches, when new, gave fairly satisfactory results, but later on considerable trouble was experienced from the stopping up of the flues and organ pipes, even though we fired with coke regularly once a week to burn out and clean the flues of accumulated unconsumed carbon, besides applying such other remedies as suggested themselves from time to time for this difficulty.

During the year 1893, we constructed, in the same old arches, six new benches of 6's of the semi-recuperative type, the arrangement of which differs materially from those mentioned above, in that more attention is given to the strength of construction, larger flues, and the abandonment of the upright organ pipes so called. We again deepened our furnaces in order to secure the space necessary within the bench for the proper mixing of the air and gases to secure complete combustion.

We commenced firing two of these benches on the 4th of October, 1893, having previously brought the heats to good condition with coke firing. From October 4th to October 27th we continued to use coke exclusively; and from October 27th, the date we started the third bench, coke and nut coal were used, coal in the first two benches fired (Nos. 5 and 6).

Beginning with November 1st, we used coal in all three of the benches under fire with the following results for the ensuing four months:

Table No. 1.

November—	
Coal used in furnaces	288,510 pounds.
Coal carbonized—retorts	827,650 pounds.
Gas made	3,573,000 cu. feet.
Average weight of charge	279 pounds.
Average time of charge	4 hours.
Average yield per retort	6,975 cu. feet.
Coke made	552,700 pounds.
Coke made for sale	534,400 pounds.
Coke used in furnaces Sundays	18,300 pounds.
Coal in furnaces per 1,000 cu. ft. gas made	80.70 pounds.
Coke " " " "	5.12 pounds.
December—	
Coal used in furnaces	312,800 pounds.
Coal carbonized—retorts	902,530 pounds.
Gas made	4,441,000 cu. feet.
Average weight of charge	302 pounds.
Average time of charge	4 hours.
Average yield per retort	8,056 cu. ft.
Coke made	580,120 pounds.
Coke made for sale	559,080 pounds.
Coke used in furnaces Sundays	21,040 pounds.
Coal in furnaces per 1,000 cu. ft. gas made	70.44 pounds.
Coke " " " "	4.73 pounds.
January—	
Coal used in furnaces	285,120 pounds.
Coal carbonized—retorts	835,390 pounds.
Gas made	4,011,000 cu. feet.
Average weight of charge	319 pounds.
Average time of charge	4 hours.
Average yield per retort	8,270 cu. feet.
Coke made	513,320 pounds.
Coke made for sale	501,800 pounds.
Coke used in furnaces Sundays	11,520 pounds.
Coal in furnaces per 1,000 cu. ft. gas made	71.08 pounds.
Coke " " " "	2.87 pounds.
February—	
Coal used in furnaces	170,230 pounds.
Coal carbonized—retorts	524,900 pounds.
Gas made	3,471,000 cu. feet.
Average weight of charge	320 pounds.
Average time of charge	4 hours.
Average yield per retort	8,236 cu. feet.
Coke made	392,790 pounds.
Coke made for sale	331,690 pounds.
Coke used in furnaces Sundays	11,000 pounds.
Coal in furnaces per 1,000 cu. ft. gas made	68.89 pounds.
Coke " " " "	4.45 pounds.

Recapitulation—Four Months. Coal for Fuel.

Coal used in furnaces four months—	
Chestnut	183,510 pounds.
Nut	95,950 pounds.
Mixed	47,690 pounds.
Pea	24,300 pounds.
Lump	705,210 pounds.
Total.	1,056,660 pounds.
Coal carbonized—retorts.	3,090,470 pounds.
Gas made	14,496,000 cu. feet.
Average weight of charge	305 pounds.
Average time of charge	4 hours.
Average yield per retort	7,884 cu. feet.

Coke made	2,038,930 pounds.
Coke made for sale	1,926,970 pounds.
Coke used in furnaces Sundays	61,860 pounds.
Coal in furnaces per 1,000 cu. ft. gas made	72.78 pounds.
Coke " " " " "	4.26 pounds.

It will be noted by the above that there were numerous grades of coal used, and it might have been interesting to have shown results with the use of each grade of coal, but that would have entailed so many figures that, for the purpose for which this report is intended, it would be unnecessary.

Our endeavor was to use the cheaper grades of coal whenever we could get them. We could always get lump coal, but the operations of the mines have been alwaps so irregular as to prevent our getting the smaller sizes without the great inconvenience of patronizing different mines in the vicinity, the product of which, strange to say, differs very materially; besides the end of the season, during which we would probably continue the manufacture of coal gas, was approaching, and I did not care to experiment too much and risk what I considered a fairly good thing for an uncertainty.

In the above calculations I have purposely excluded the results obtained when coke was used exclusively, but for purposes of comparison I have appended the results obtained during a corresponding period one year later, using the same benches, but with coke for fuel.

Table No. 2.

November—	
Coke used in furnaces	111,400 pounds.
Coal carbonized—retorts	709,000 pounds.
Gas made	3,588,000 cu. feet.
Average weight of charge	358 pounds.
Average time of charge	4 hours.
Average yield per retort	9,918 cu. ft.
Coke made	425,400 pounds.
Coke made for sale	314,000 pounds.
Coke in furnaces per 1,000 cu. ft. gas made	32.46 pounds.
December—	
Coke used in furnaces	119,900 pounds.
Coal carbonized—retorts	771,000 pounds.
Gas made	3,723,000 cu. feet.
Average weight of charge	371 pounds.
Average time of charge	4 hours.
Average yield per retort	9,999 cu. ft.
Coke made	662,600 pounds.
Coke made for sale	350,860 pounds.
Coke in furnaces per 1,000 cu. ft. gas made	33.68 pounds.
January—	
Coke used in furnaces	118,600 pounds.
Coal carbonized	729,600 pounds.
Gas made	3,460,000 cu. feet.
Average weight of charge	360 pounds.
Average time of charge	4 hours.
Average yield per retort	9,502 cu. feet.
Coke made	412,240 pounds.
Coke made for sale	293,640 pounds.
Coke in furnaces per 1,000 cu. ft. gas made	35.66 pounds.
February—	
Coke used in furnaces	110,700 pounds.
Coal carbonized—retorts	659,300 pounds.
Gas made	3,236,000 cu. feet.
Average weight of charge	361 pounds.
Average time of charge	4 hours.
Average yield per retort	9,461 cu. feet.
Coke made	392,280 pounds.
Coke made for sale	250,880 pounds.
Coke in furnaces per 1,000 cu. ft. gas made	34.29 pounds.

Recapitulation—four months. Coke for Fuel.

Coke used in furnaces	460,600 pounds.
Coal carbonized—retorts	2,868,900 pounds.
Gas made	14,007,000 cu. feet.
Average weight of charge	362 pounds.
Average time of charge	4 hours.
Average yield per retort	9,720 cu. feet.
Coke made	1,692,520 pounds.
Coke made for sale	1,209,480 pounds.
Coke in furnaces per 1,000 cu. feet gas made	32.88 pounds.

Table No. 3.

	Coal.	Coke.
Gas made as above (four months)	14,496,000 cu. ft.	14,007,000 cu. ft.
Fuel under retorts	1,056,660 lbs.	466,600 lbs.
Coke	61,860 lbs.	
Coal carbonized—retorts	3,090,470 lbs.	2,868,900 lbs.
Cost of coal and coke at $1.97 1-3 and $6 per ton	$1,042.57	$1,381.80
Coke	185.58	
Fuel under retorts per 1,000	72.78 lbs.	32.88 lbs.
Coke	4.26 lbs.	
Cost per 1,000—fuel under retorts	.0847 cts.	.0987 cts.
Coke made for sale	1,926,970 lbs.	1,209,480 lbs.
Value of coke made for sale	$5,780.00	$3,628.44
Excess cost of coke over coal		153.65
Excess cost per 1,000 coke over coal		.0109 cts.
Excess value of coke made for sale when using coal	$2,151.56	
Excess value per 1,000 of coke made for sale when using coal	.1536	
Saving when using coal	2,305.21	
Saving when using coal (per 1,000)	.1645	

Analyzing these figures one would at once see that a larger number of retorts would be required with coal for fuel than with coke; also that there would be additional labor required, and which I have estimated as follows:

To make 200,000 cubic feet coal gas per day with coke for fuel, the average yield per retort (14 inches x 23 inches x 8½ feet) being 9,270 cubic feet, would require an average of 20.57 retorts; whereas with coal, the average yield being but 7,884 cubic feet, there would be required 25.37 retorts, and the additional labor of one man.

We would then have:

Additional labor (one man four months)	$210 00
Interest—cost of additional bench (four months)	12 50
Wear and tear (four months)	104 20
Total	$326 70
Saving when using coal (as above)	2,305 21
Net saving when using coal as above	1,978 51

This amount if extended to one year would be sufficient ($5,935.53) to pay for the renewal of the entire six benches.

These figures are not given because I think there is anything very remarkable about them, but only to show from the facts as they exist that even with very ordinary results, so far as gas production is concerned, that there is an opportunity for economy in the use of coal for bench firing, where the conditions are favorable to its use.

The foregoing tables represent but the first extended trial of coal, and were not entirely satisfactory, since the results obtained did not approach as near to coke *in pounds per thousand* as I had reason to believe was possible.

From March 4th to March 31st, a period of 27 days, another trial was made, during which time the writer had opportunity to give to the bench more of his personal attention than before, and succeeded in greatly improving the work as will be seen by the following:

Table No. 4.

From March 4th to March 31st inclusive—	
Coal in furnace (slack)	174,080 pounds.
Coal carbonized—retorts	598,880 pounds.
Gas made	2,938,000 cu. feet.
Average weight of charge	344 pounds.
Average time of charge	4 hours.
Average yield per retort	9,417 cu. feet.
Average yield per pound	4.95 cu. feet.
Coke made	359,330 pounds.
Coke made for sale	342,230 pounds.
Coke used—furnaces	17,100 pounds.
Slack in furnaces per 1,000	59.25 pounds.
Coke " "	5.16 pounds.

It will be noted here that slack coal was used which at $1.17 per ton was very cheap fuel, also that the yield per retort approached very close to that obtained when coke was used, but still high in pounds per thousand, although reduced considerably from the former trial.

It is not my desire to burden you with to many tables of results, for I realize that there is little or no interest in this report to those not similarly situated and conditioned, but a recent trial extending over a

period of 39 days furnishes figures so interesting that I will give them, even at the risk of becoming monotonous.

They are as follows:

Table No. 5.

Period of 39 days in August and September—

Fuel under retorts	91,700 pounds.
Coal carbonized	425,950 pounds.
Average weight of charge	308 pounds.
Average time of charge	4 hours.
Average yield per retort	9,678 cu. feet.
Coke made	255,330 pounds.
Coke made for sale	255,330 pounds.
Fuel under retorts per 1,000	40.98 pounds.
Gas made	2,242,000 cu. feet.

It will be noted here that the yield per retort is good, that all the coke produced was saved for sale and that the "fuel under retorts" has been reduced to a very low figure. With these results I am very well satisfied, and it is our purpose to continue the use of coal for fuel purposes so long as there is reasonable demand for coke.

Discussion.

Mr. Thompson—Mr. Pratt has given us a most straightforward account of his experiences with coal-fired benches, which is the more valuable because stating the results which were only partially successful, as well as the more satisfactory figures attained later. With coal fuel it is very soon apparent that the degree of intelligent attention required of the fireman is greater than with coke; for not only is the shipment of nut coal dependent upon the quantity of lump coal mined, and consequently liable to interruption during summer, but the well-known variations between the gas coals from different pits in the same immediate neighborhood are quite as noticeable and pronounced with nut fuels, and the same shipper sometimes sends several widely differing coals in a single month. Our experience with coal fuel at St. Louis covers a period of about five years, in which time we have had 40 benches of 5's and 6's in use, with a form of furnace which, from some terms in Mr. Pratt's description, I judge to be the same as his. A very material economy over the cost with coke was effected and quite satisfactory results were made; yet the installation was hardly fair to this form of furnace, since our narrow arches (only 6 ft. 8 ins. wide) contracted the recuperator space and combustion chamber, and much of the difficulty in clearing the passages and their consequent failure to maintain full efficiency was directly due to the out-of-date arches. As Mr. Pratt states of his own practice, we also burned coke about once a week to clear the soot from the flues, choosing Sunday for this to reduce the quantity of coke piled in the yard on that day. But some of the difficulties of regulating the heat were well shown in thus changing fuels, for at these times, as well as when we fell back on coke because our coal shipments were interrupted, there was a decrease in the retort heats in spite of our care, whether changing from coal to coke, or back from coke to coal. For this reason, and on account of the relative cheapness of coal fuel, we abandoned this method of clearing the flues, and instead used about once a week an excess supply of air, with a little steam injected at the main outlet flue to increase the draught. In the spring of 1894 the necessity of renewing both arch work and benches in one of our stacks at Station B. gave us an opportunity to install a form of setting that embodied and somewhat enlarged upon the features of coal firing in *old style* furnaces which had already proved so successful at our Station A; and there was accordingly erected a stack of 16 benches of 4's, with retorts 19 ins. x 31 ins. x 9 ft. 3 ins. inside dimensions, over "straight-fire" furnaces. Had we not been blessed with a very cheap fuel coal and a good market for coke, the recuperator form of furnace would not thus have been disregarded; but, under the circumstances, the choice was largely influenced by two beliefs—first, that a considerable portion of the saving attributed to regenerators is due as much to the provision of the air for completing combustion, *just where it is needed*, as to its preheatiug; and, second, that it does not pay to erect expensive recuperators to save a cheap fuel. I have prepared a table giving some details of the results with these benches. In reporting the fuel consumption I prefer to state it in weights per ton rather than per thousand, as the varying factor of gas yield is thus eliminated. For instance, in Mr. Pratt's Table No. 4, the total fuel is given at 64.41 pounds per 1,000, which works out 638.4 pounds per ton carbonized; the yield of gas per pound figuring 4.906 feet. In Table No. 5, the fuel per 1,000 is 40.98 pounds; but the yield is 5.264 feet, and the fuel per ton is 430.5 lbs. Compared by the 1,000 feet made, the fuel weight is 57.17 per cent. higher in Table No. 4 than in No. 5; but, figured by the ton carbonized, it is but 48.29 per cent. higher; and this latter, as the charges were doubtless equally well burned in each case, seems the more equitable comparison. Our table is as follows:

1894.	Weight per Charge.	Fuel per Ton Carbonized—Lbs. Coal.	Lbs. Coke.	Lbs. Breeze.	Total Wt.
November*	392.6	552.0	96.0	...	648.0
December	431.2	551.4	25.1	...	576.5
1895.					
January	447.1	615.6	26.4	...	642.0
February	454.9	522.8	45.1	...	567.9
March	453.8	536.8	17.1	...	553.9
April	452.6	543.9	21.4	...	565.3
May	453.5	495.6	28.6	...	524.2
Six mos. averages	448.8	544.3	27.3	...	571.6
June	453.6	369.3	28.7	170	568.0
July	453.5	384.1	23.2	140	547.3
August†	445.3	378.7	25.1	140	543.8
September†	445.2	395.5	22.5	120	538.0
Four mos. averages	449.4	381.9	24.9	142.5	549.3

* Includes fuel for benches under slow fires.

† Charges reduced on account of hot weather.

It will be be noticed that during the four months just past, while the weight of fuel has been reduced, an even greater reduction in cost has been attained by substituting for part of the coal the cheaper coke breeze. The coke is only used to bring the fire quickly to effective condition after clinkering. All charges have been of four hours duration, and the heats are uniformly high and even, as several gentlemen now in the hall, who have visited the works, will testify. To meet the requirements of the three varieties of coal which we carbonize, the weight of charge ranges during each day from 425 pounds to 475 pounds; but for about one third of the whole carbonization the latter weight, with a local gas coal, has been maintained without reduction the whole of the present year. On one occasion, with all coke fuel, we ran for 24 hours, charging 500 pounds on all three kinds of coal, or 1½ tons per mouthpiece per day.

The essential novelty in the construction of these benches is the provision of five ports for the admission of air in the face of the bench *above* the furnace—three being at uniform distances, one above another, in the middle of the bench, and one at each side near the pier-wall and slightly below the upper retort. Each port has a loosely fitting cover, some being similar to the cap for a stove-pipe hole, and some being boxes with slides like those for regenerators. The uptake flues are provided at the top with stack dampers, of the form described in the Western Gas Association's "Wrinkle Department," in 1894. When the furnace is first filled all the ports are opened wide, but for a few moments, with our degree of draught, smoke issues from the chimney nevertheless. As its quantity decreases the ports are closed one by one, the side ones first; and by the time the furnace coal is wholly coked the stack-damper is also pulled down nearly tight. Under the conditions of a coal fire a large opening is required and a good draught, while with coke there should be a restricted outlet and almost a pressure in the bench. Both of these requirements we thus fulfill, though when mixing breeze with the coal this handling of the stack-damper is of less importance, and the uptake is only fully closed when the furnace is being clinkered.

To facilitate comparisons of results, I have reduced to percentages, on each of the several bases which are employed in such estimates, the averages of the past four months, during which our trials with breeze have been made, and whose practice we expect to follow. These results figure:

	Per Cent.
By weight, based on the weight of coke produced (35½ bu. per ton)	42.98
" " " " coal carbonized	27.47
By cost, " " value of coke produced	12.58

Our satisfaction with these results is perhaps best indicated by the fact that we are just completing a second stack of 16 benches, exactly like the one now in use. If my recollection is not at fault, it is within 7 years that the first paper on coal fuel for bench firing was read before one of our Associations; and at that time, like many another new departure, it was regarded as an interesting novelty rather than as the important factor in economy which it has since become to many of us. Humorous questions were then asked, prompted by a paragraph in this first paper, as to what make of shot gun was best adapted for clearing the flues, etc. But in the West, to-day, coal firing has come to stay; and I expect to see it generally adopted whenever the fuel is obtainable at anything like the prices now ruling in the districts within 100 miles of the mines.

Mr. Mitchell—About 1882 I found it necessary to improve the condi-

tion of our furnaces. We had a good demand for coke, and the free firing benches we were using consumed a large portion of the coke we made. I therefore devoted my attention to developing a system of firing by which I would be able to heat my benches and save the coke for sale. With this view I began to experiment in the construction of a furnace which would produce the highest heat with coal. After various attempts I settled upon the furnace we are now using, and I fully believe the construction of my furnace at present is as near perfection as a half-depth furnace can be made, to obtain the best results with the minimum of fuel. In my bench all the conditions requisite for a perfect smoke consumer are there. The white-hot walls of the settings and retorts maintain the temperature of the carbon until perfect combustion takes place. All that is necessary to insure this perfect combustion is the proper supply of air to these unconsumed gases. This is easily and effectively accomplished by taking the air in through a system of recuperators situated below the lower retorts. In my works we are using the organ pipes, spoken of in the paper just read, for heating the air. We have had this system in use for 12 years. The size of the vertical pipes was 3 inches and the length was 12 inches. We have lately increased the diameter of the pipes to 5¼ inches. This in my judgment is the simplest method I know of for heating the air going into a retort bench. The advantages are: 1st. The very short travel the gases have to make to get into the main flue. 2d. The comparatively thin heating surface of the sides of the organ pipes, which give out their heat quick ly. 3d. The vertical position of the pipes renders them not liable to break or give way. 4th. The cheapness with which they can be renewed. In any new style of furnace of regenerative character experience is necessary to obtain the best results, and whilst I claim to have been the first to call the attention of the gas fraternity to the economy and advantages of firing gas benches with coal, experience prompted me to make improvements in the construction required by the higher heats obtained from the furnace. I am confident, after an experience of many years, that my present construction is amply strong to withstand any heats or changes incident to the working of a regenerative bench. In the manipulation of coal-fired furnaces the extra work is not so great as at first sight appears. The furnace man feeds very little more weight of fuel into the coal furnace than he does into a coke furnace, and it is done quicker because of its less bulk. The extra coke to be wheeled away comes upon another man, and this work is divided. The clinkering or cleaning of the furnace is not more laborious in my judgment than with coke, but the fires require a more frequent shaking up. In Table No. 5 the results as given are good, and I do not think Mr. Pratt need have any fear of competition from outside companies with any other system of gas making.

Mr. Russell said it was of great importance in soft coal burning benches to obtain perfect recuperation. Retort manufacturers had endeavored to reduce to a minimum the liability of the benches to settle. In the West it had generally been thought desirable to so change the arches as to burn either coal or coke; and he had no doubt that at some time or other the cost of making such change would be saved.

Mr. Harper had changed 50 per cent. of his benches to permit the use of coal, and had obtained very satisfactory results. He had found less difficulty in working coal fire benches than in using coke.

Mr. Ramsdell thought the utility of soft coal firing was to be determined almost entirely by condition of the coke market. He had used soft coal (at times when coke was in demand) in ordinary benches, with very little trouble and with good results.

[To be Continued.]

On the Technical Analysis of Asphalts.

By Samuel P. Sadtler, Ph.D.

In an article published in the *Journal of the American Chemical Society*, for December, 1894, Miss Laura A. Linton gave, under the above heading, a most valuable discussion of the present methods of asphalt analysis. As she well says, the "petrolene" of the writers on asphalt "is nothing but a name that covers a great variety of substances, radically unlike, that exist in different forms of bitumen, and are only related in this instance as being held in solution by a certain limited number of menstrua, and which include the whole list of paraffines and isoparaffines, the olefines, the benzenes and additive benzenes, with many other less abundant and well-known substances." Similarly, "in a general way, it may be said that asphaltene is that portion of the different forms of bitumen that is soluble in carbon disulphide, chloroform, benzene, and a few other less known liquids, and is not soluble in the menstrua that dissolve petrolene."

Miss Linton recommends, therefore, as a process for uniform treatment of asphalts, to digest them first with petroleum ether, decanting the liquid upon a filter, and ultimately the undissolved bitumen also. After getting the weight of the filter and contents, it is treated with boiling turpentine, with which it is digested for some time, the funnel being covered. After repeating this treatment until the filtrate becomes colorless, chloroform is taken to finish the extraction of the asphaltene. After another weighing of the filter and its contents, it is to be burned in a platinum crucible, in order to determine the organic non-bitumen and ash.

This process of Miss Linton, while giving results that are comparable, becomes very tedious in practice, besides requiring the use of three solvents, of which one (the boiling turpentine) is unsatisfactory because of its resinous and sticky tendency.

I have sought, therefore, to find a more expeditious process without sacrificing completeness of extraction, or allowing the results to fail in comparability.

With this in view, I have chosen a form of apparatus in which a continuous extraction can be carried out without requiring the transference of the weighed sample from one vessel to the other. The solvents chosen are definite compounds of fixed boiling point, which can always be had pure and subject to no alteration; the extraction goes on continuously at the boiling point of the solvent; and the solvents are recovered for use again.

The solvents chosen are acetone, as a substitute for the petroleum ether, for the extraction of the petrolene; and chloroform, for the extraction of the asphaltene. Both acetone and chloroform can be had perfectly pure, and are not alterable, so that they possess distinct advantages over petroleum ether and carbon disulphide.

The analysis is carried out as follows:

An asbestos filter is made in a weighed Gooch crucible, and dried. About 10 grams of fine white sand, previously ignited and cooled, is added, and a piece of stout platinum wire, about 3 inches long, is placed in the crucible, and the whole dried to a constant weight of 100° C.

Then 1 to 2 grams of the asphalt, in fine powder if a solid, are added, gently mixed with the upper portion of the sand layer with the aid of the platinum wire, care being taken not to disturb the asbestos filter below. The weight of the whole is accurately taken, inclusive of the wire and the crucible, and its contents are then dried at 100° C. to a constant weight, either in an air bath or water oven, cooled in a desiccator and weighed. If the sample be a maltha (liquid bitumen), it is gently mixed with the sand layer, after slightly softening it with the aid of the drying oven. The loss at 100° C. is calculated and called "moisture and loss at 100° C." The crucible and its contents are then placed in a continuous extraction apparatus, formed by placing a small percolator within a larger one, the inner one being held in position by a perforated cork. The crucible having been placed in the inner percolator, the outer one is connected with a flask containing the solvent, and with an upright condenser. The flask is heated either on a sand bath or a water bath, the former being preferable, since when once regulated it needs no attention or renewal as does the water bath. The extraction with acetone, which is first undertaken, is continued until the loss on extracting for two hours is not more than 1 or 2 milligrams. The loss of weight after this extraction, as compared with the weight on starting the extraction, is calculated and called "petrolene." The extraction is then continued in the same manner with chloroform, and the final loss is the "total bitumen." The time necessary to effect a thorough extraction varies greatly with the different asphalts, but will not amount to more than twelve hours for the acetone and eight hours for the chloroform extraction. The loss in weight should be taken first after four hours, and then every two hours until the extraction is complete, the crucible and contents being dried at 100° C., and cooled in a desiccator each time. The residue in the crucible then represents the organic non-bitumen and mineral matter. It is ignited, after placing the cap on the bottom of the crucible, and the loss calculated as "organic non-bitumen," while the remainder is the "mineral matter" or "ash."

Duplicate analyses of two well-known varieties of asphaltum were made to test the method:

Refined Trinidad Asphalt.

	I.	II.
Petrolene	46.40	46.41
Ashaltene	15.14	15.20
Organic non-bitumen	3.02	2.95
Mineral matter	35.44	35.44

Refined Bermudez Asphalt.

	I.	II.
Petrolene	66.47	66.45
Asphaltene	29.66	29.71
Organic non-bitumen	1.76	1.73
Mineral matter	2.11	2.11

As an example of a maltha, or liquid bitumen, examined by this method, may be given the following analysis of

Alcatraz Liquid Asphalt.

	Per Cent.
Petrolene	89.21
Asphaltene	9.39
Organic non-bitumen	trace.
Mineral matter	1.40

In publishing this note I wish to acknowledge my indebtedness to Mr. H. Blount Hunter, my assistant, for the very intelligent and skilful way in which he has carried out most of the experimental work.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. THOMAS G. LANSDEN has removed his St. Louis offices from Room 206, Security Building, to Room H, 108 North 4th street, that city.

ALL the gas and electric lighting interests of Oroville, Cal., are now controlled by the Oroville Gas Company.

THE Muskegon (Mich.) City Council has agreed to the extension of the franchise asked for by the proprietors of the Muskegon Gas Light Company, the main features of which agreement will be found in the JOURNAL for October 14th. The franchise becomes operative on the 16th inst.

WE understand that the shops of the Miller Gas Engine Company, formerly located in Urbana, O., will be established in Springfield, O.

THE Berlin Iron Bridge Company, of East Berlin, Conn., has just completed, for Mr. James McLaren, of Brooklyn, N. Y., a new building for housing his extensive system of stone cutting works. The yard is 70 feet wide and 120 feet long, and the building covers it completely. A feature of the equipment and arrangement is the placing of a travelling crane up to 15 tons capacity, so that the stone material can be changed about from any part of the yard by power means.

MR. GEORGE R. HARMS, formerly Mayor of Newport, Ky., and President of the Newport Light Company, has obtained valuable patents to mining properties in Southern Mexico, from President Diaz. Some days ago, on his return from the land of the "Greasers," he was dined by several of his Cincinnati and Newport friends, and among other things related by the genial Harms respecting that which was to be found on the "patented lands" was this: "It may sound incredulous, but there is an old Mexican woman on our tract, who lives in a little cabin, the rafters of which are of solid but unrefined silver." A response made to this statement was to the effect that that Mexican female must look up to the ceiling rather than under the bed, when the time for sleeping came.

WE cannot forbear printing the following extracts from a letter received by us from Mr. Arthur E. Boardman, dated Brevard, N. C., November 1st:

"Dear JOURNAL: * * * I was awfully disappointed not to be present at the Philadelphia meeting of the Association. Had made all arrangements to go, when Mrs. Boardman was taken sick, and had to relinquish the proposed visit. I expected to share in the discussion of Mr. A. C. Humphreys' paper, although I had its text only a day before I should have started for Philadelphia. I do not know that I could have added anything to the discussion, but would have enjoyed emphasizing the admission that illuminating value is a product of volume and intensity, and that the photometer has limits to its value as a light measurer. * * *."

THE adjourned annual meeting of the Brookline (Mass.) Gas Light Company, which was set for 10:30 A.M. of October 30th, was postponed until the 27th of this month.

ON October 21st we reported that an application for a franchise for a gas charter for Mt. Clemens, Mich., was being considered by the City Council, and we are now in position to state that the authorities have authorized Messrs. William S. Parker, Frank Hale, Joseph H. Holman, J. F. Upleger, Michael M. Smith and William H. Merger "to maintain and operate sufficient gas pipes and conductors to supply all customers of the Mt. Clemens Gas Company with gas for a period of 30 years, subject to all ordinances now in force. The proprietors to file a bond at once, in the sum of $10,000." It is stipulated that the President and Secretary of the Company shall at all times be residents of Mt. Clemens. The Company has until August 1, 1896, to complete its works.

MR. WILLIAM H. SHAFER, at one time a member of the Wheeling (W. Va.) Board of City Gas Trustees, died on the 29th of October.

A VERY cleverly put together "campaign document" was that issued towards the close of October by the Keystone Meter Company, of Royersford, Pa. In common with other seekers after public favor, the the Keystone Company asked for a straight vote, and it further had the temerity to ask the voters to send in their orders early and often.

THE following letter, and our reply thereto, are self-explanatory:

HENRY S. JACKSON, GAS MACHINERY,
25 OLIVER STREET, BOSTON, MASS., Nov. 4, 1895.

To the Editor AMERICAN GAS LIGHT JOURNAL: A note in your issue of to-day regarding a possible gas supply for Barre, Vt., reads as follows: "* * * Its population, however, which does not exceed 2,500, seems to be altogether inadequate to the fair support of a gas company." Where you obtain your information I do not know, but the United States census for 1890 gives the population of Barre, Vt., as 4,146, and the State census (just completed) gives 6,800. It may not be regarded as of much importance to the general public whether the number be 2,500 or 7,000; but to men who are asked to invest their money in Barre it is quite an essential factor. It would also appear desirable for a JOURNAL of reliability to be sure of its facts before asking its readers to believe what is found in its columns. Very truly yours,

H. S. JACKSON.

[To begin with, we feel quite sure that no other man than Mr. H. S. Jackson would quicker admit that the JOURNAL's best desire and purpose are nothing short of reliably serving our readers. In the item referring to the proposed gas works at Barre our figures as to its population were obtained from "Lippincott's Pronouncing Gazetteer of the World," edition of 1893, a compilation which has for years been accepted as authoritative in this country. On the receipt of Mr. Jackson's letter, in the attempt to confirm our position or his, the *Gazetteer*, we find unfortunately can be quoted to sustain the JOURNAL and himself in our widely varying statements. On page 590 of the Lippincott work (10th place from bottom of second column) where the standing of the post village of Barre is defined, its population is distinctly given as 1,882. Making what we considered a liberal estimate for the increase in population, between the years 1892 and 1895, we put the number at 2,500. So far our position is completely sustained; but a reference to the tables in "Lippincott" relating to the "Census returns of 1880 and 1890, compared" which are to be found in the opening pages of this usually coherent book, as a whole, the following figures are found: Barre, Vt., post village, Washington county, population, 1880, 1,025; 1890, 4,146; which latter figures sustain Mr. Jackson's contention, and further reveal the astonishing vitality displayed by Barre. With this fair explanation of the case, we again submit that Mr. Jackson will not deny our desire to be reliable.—EDS.]

THE following is the text of the ordinance, as amended and completed by the Memphis (Tenn.) City Council, on the night of October 29th, relating to the supply of gas in that city:

"Be it ordained by the Legislative Council of the city of Memphis:

"Sec. 1. That all Gas Companies within said city, furnishing light to it and its inhabitants, by means of pipes or other conductors, laid in or under the streets or sidewalks of said city, shall be and they are hereby required to furnish gas of not less than 16-candle power, and that the same shall be as free from deleterious and hurtful elements as practicable.

"Sec. 2. That the rate to be charged for gas so furnished, either to said city or to the inhabitants thereof, shall not exceed the sum or price of $1.50 per 1,000 feet when paid within the customary discount days, with the right on the part of said Company to add 5 per cent. thereto if not so paid.

"Sec. 3. That the office of gas inspector is hereby created, to be filled by the Legislative Council, on the nomination of the Mayor, at the next regular monthly meeting after the final passage of this ordinance. He shall hold office for one year, and shall give bond in the sum of $5,000 for the faithful performance of his duties. His compensation shall be fixed by the Fire and Police Commissioners, and paid out of the lighting fund. It shall be the duty of such inspector to see that the gas furnished is of the quality and illuminating power above described; that the gas meters furnished properly measure the gas passing through them, and generally such other services as may from time to time be imposed upon him.

"Sec. 4. That no meter shall be inspected except at the instance and request of the consumer, and a fee of 50 cents shall be paid by the con-

sumer in advance to the inspector for such inspection. All such inspection fees shall be reported every Monday by the inspector to the Secretary of the Council, and shall be turned over on the same day to the County Trustee, for the credit of the Lighting Board.

"Sec. 5. That this ordinance take effect on and after the 1st day of November, 1895."

WHILE we cannot speak with authority respecting the attitude of the two Memphis Gas Companies towards this ordinance, we nevertheless incline to the view that they will work under its provisions without contest.

MR. CHARLES D. SHERMAN, of New Haven, Conn., has been appointed Superintendent of the Meriden (Conn.) Gas Light Company, succeeding the late Mr. James A. Hadley.

MR. G. A. ALLEN, Secretary of the Zanesville (O.) Gas Light Company, writing to the JOURNAL under date of the 4th inst., says: "As an evidence that our Company is trying to keep up with the procession, I inclose clipping from a local paper concerning the latest action of our Board of Directors. Our business is good and increasing, the people and the Gas Company are friends, and by doing our part we hope for and expect a continuance of this friendly feeling, which makes it a pleasure to do business."

THE clipping inclosed by Secretary Allen is appended: "By reference to a notice elsewhere it will be seen that the Gas Company intends that the public shall receive the advantage that accrues from the increased consumption of gas. This has been its pronounced policy for a number of years, and one reduction has followed another until now, with gas at $1 per 1,000, is cheaper than oil for light. At the new price, as fuel for cooking purposes, and for light, everybody can afford to use it, because there is nothing else so convenient or cheap. That the public appreciates this manner of fair dealing is shown in the popularity of the Gas Company and in its constantly increasing business."

MR. JOHN F. COLBY, a Director of the Bangor (Me.) Gas Light Company, died at his home in Bangor towards the close of October last. He was born in Athens, Me., January 27, 1836, and removed to Bangor when a small boy, and there the remainder of his life was spent. He was very prominent in almost everything that concerned the best interests of Bangor.

AT the last meeting of the Charlestown (Mass.) Improvement Association it was voted to petition the Board of Gas and Electric Light Commissioners for a rate of $1 per 1,000 cubic feet for gas supplied in the Charlestown district of Boston, and the Secretary of the Association was instructed to communicate with the Board in respect to the obtaining of such a concession. The Board, through Chairman Barker, answered the communication as follows: "Dear Sir—We have the honor to acknowledge the receipt this day of your letter showing the action of the Charlestown Improvement Association relative to the price of gas in the Charlestown district, and we have called the attention of the Company to the same. As you are doubtless aware, the law gives the Board no authority over the price, except after a formal hearing based upon a written complaint signed by actual consumers."

DURING the last week in August Comptroller Coffey and Chamberlain Bridgman, of Troy, N. Y., were served with an order from Justice Parker, directing them to permit the General Assessors of Troy to correct their books and to remove from them an assessment of $504,800 made against the Troy Gas Company on account of personal property. The order states that the assessment was erroneously made, and that the Gas Company has shown that its debt exceeds its personal property—in fact, it has no personal property and should not be allowed to pay tax on any. The order was obeyed.

WE are indebted to a Philadelphia correspondent for the following clipping, from the Scranton (Pa.) *Tribune*, of November first: "After a long illness, Seward R. Smith, son of Marcus Smith, Superintendent of the Wilkes-Barre Gas Company, died yesterday, in his 17th year." The funeral services were celebrated on the afternoon of the 5th inst., at the family residence, North Washington street. The sympathy of the fraternity will go out in unstinted measure to the father thus sorely bereaved.

MR. JOHN A. BRITTON, Secretary of the Oakland (Cal.) Gas Light and Heat Company, has notified the Board of Supervisors that hereafter the charge for gas supplied to the County Buildings would be $1.75 per 1,000 cubic feet, a concession of 50 cents per 1,000.

WRITING of this recalls the sudden illness of Mr. Joseph G. Eastland, the respected President of the Oakland Company, who was stricken with paralysis some weeks ago. It is our pleasing duty to say that his improvement in health has been such, that his restoration to his former unimpaired physical condition is assured.

THE Minneapolis (Minn.) *Journal* of the first inst., said: "The control of the St. Paul (Minn.) Gas Light Company and its illuminating interests is about to pass into new hands. The deal is not yet a finality, but it is a foregone conclusion and will be consummated, unless something unforseen should happen, as soon as the investigation of the Company's affairs now in progress has been completed. Any statement to the effect that the Company has sold out entirely is false and misleading. The purchase now under consideration includes not more than 8,000 shares of the 15,000. It is equally false that the St. Paul stockholders have sold out. They have reduced their holdings so as to give the purchasers control, but are still interested."

JACOB JACOBS recently began suit against the San Francisco Gas Light Company, in the Justices' Court of San Francisco. He claims damages in the sum of $299.99, for injury to his house on Union street, that city, resulting from an explosion of gas on August 23rd. The explosion, he alleges, was caused by the poor and negligent workmanship of defendants' employees, owing to which gas escaped into the house.

SUPERINTENDENT PIERSON, of the Capital Gas Company, of Sacramento, Cal., denies positively, the truth of the statements recently made that its property and rights were to be taken over by the Sacramento Electric Power and Light Company.

COMMISSIONER ROSS, of the District of Columbia, when asked his opinion respecting the recommendation adopted by the Washington (D. C.) Board of Trade, urging that the plant of the Washington Gas Light Company be purchased for operation on municipal account, replied that he did not think it would be a wise thing to do. He opposed on general principles, because he belonged to the school of politics which does not favor government ownership of such properties.

THE annual meeting of the Consumers Gas Company, of Toronto, Can., was more than ordinarily interesting, but completely harmonious. From the reports it was learned that during the Company's fiscal year 3 miles of additional mains had been laid, bringing the total mileage to 229. Services to the number of 942 were put down. The number of street lamps was 1,145, or 19 less than in the preceding year. The meters number 20,626, an increase of 1,322. The gas rental receipts amounted to $558,590, an increase of $14,264. The increase in the quantity of gas sold is attributed to the demand for fuel use; and it is noted that the price for gas coal was lower than a year ago, whereas gas oils have increased considerably in price. The total receipts from all sources were $616,168.51, thus credited: Gas rents, $558,590.12; office rents, $2,135; tar, $16,391.37; coke, $32,682.39; ammoniacal liquor, $6,369.63. The officers elected to serve during the year are: Directors, James Austin, Dr. L. W. Smith, Samuel Alcorn, M. Baldwin, G. S. C. Bethune, Henry Cawthra, G. R. R. Cockburn, M.P., Isaac C. Gilmor, George Gooderham, James Scott, Sir Frank Smith, Thomas R. Wood and W. H. Pearson; President, James Austin; Vice-President, Dr. L. W. Smith; General Manager and Secretary, W. H. Pearson.

MR. STEPHEN HAYES CONDICT, formerly a Director and Vice-President of the old Newark, N. J., Gas Company, died at his residence, No. 74 Park Place, Newark, on the morning of the first inst. He was in his 80th year, and had amassed a fortune, the major portion of which was accumulated in the saddlery and harness trade. The funeral services were celebrated at the residence, on the afternoon of Monday, the 4th inst.

A FEATURE of the gas outlook at Harrisburg, Pa., is the placing there, by the Harrisburg Gas Company, of many thousand feet of additional gas mains. When the work is completed the residents of several suburban districts hitherto unable to obtain gas can have their want supplied, and the Harrisburg Company will also have the advantage that follows the absence of "dead ends" in its distributing system.

SUPT. J. S. KANEEN, of the San Rafael (Cal.) Gas and Electric Light Company, recently met with a mishap while riding a bicycle. In fact, his escape from death was none too wide. We are glad to add that his doctor says he will recover, despite a broken arm and fractured thigh.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

EDITOR—Jos. R. Thomas, C.E.
ASST. EDITOR—T. J. Cunningham.
MANAGER—C. E. Sanderson.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 32 Pine Street, New York.

This is a recognized official organ of
LIGHT, HEAT, STEAM, WATER SUPPLY,
VENTILATION, SANITARY IMPROVEMENT,
AND GENERAL SCIENCE.

TERMS:

SUBSCRIPTION—Three Dollars per annum, in advance. Single copies, 10 Cents.

AGENTS:

New York—American News Co., 39 and 41 Chambers St.
Germany—R. Westermann & Co., of New York.

MONDAY, NOVEMBER 11, 1895.

Asbestos for Pipe Covering.

Mr. John A. McConnell recently read a paper before the Engineers' Society of Western Pennsylvania on "Heat Insulation, with Notes on Asbestos," and in the discussion which ensued Emil Swensson gave a description of the heat insulating covering of the large steam pipe line which carries the steam supply of the Keystone Bridge Works, Pittsburgh, from the Lucy Furnaces across the furnace stock yards and the A. V. R. R. tracks to and over the buildings of the bridge works. This line is composed of about 600 feet of 14-inch pipe and about 300 feet of 10-inch pipe, and is exposed to wind and weather in its entire length, being carried about 30 feet above the stock yard floor, about 24 feet above the railroad tracks, and about 22 feet above the floor level in the Keystone Bridge Works.

On account of the great height at which it had to be carried it was decided to support the pipe from below, rather than to hang it up, as is usually done, but how to do it and at the same time take care of the expansion and not interfere with or break the necessary heat insulating covering now became a serious problem. To permit a free expansion movement it was decided to support the pipe in cast iron shoes resting on roller nests. But of course the shoes could not come in direct contact with the pipe without breaking the covering.

The insulating materials being of a very porous nature, and consequently having small resistance to crushing, an experiment was made to test the strength of asbestos cement and its various modes of application suitable on this line. A 5-foot long section of the 14-inch pipe was covered in three different manners, first similarly to the proposed covering for the entire pipe line, consisting of an air space of 1½ inches, having five tin thimbles or studs to the square foot, holding a heavy wire netting away from the pipe; over the top of this was applied 2 inches thick asbestos cement in four coats.

The second kind was the same as the first, except that wrought iron gas pipe was used instead of tin for the thimbles at the saddle rest for a space of about 15 x 18 inches.

The third kind was similar to the first, except that the air space for a width of 15 inches all around the pipe was filled in solidly with wired on asbestos cement.

A saddle or shoe 12 inches square was placed on the various kinds of covering and loaded until the cement began crushing in. The first ones were both too weak, the first one being the weakest. The third showed ample strength for our purpose, carrying a load of 3,200 pounds without showing sign of crushing. As the load to be carried was about 1,000 pounds, and as the size of the shoe would be about 15 x 18 ins., the safety factor would be ample, especially after hardening of the cement.

This last described method of construction was consequently decided upon as the one to be used at the saddles.

After the asbestos cement had been put on it was covered with canvas, sewed all around the pipe, then painted with white lead, and finally the upper two-thirds of the pipe was covered with No. 24 gauge sheet iron, wired on and painted with oxide of iron.

The covering has now been on for three years and is in as good condition as when first put on. Its value as a heat insulator is best illustrated by the fact that when the uncovered pipe will burn the hand the heat can hardly be detected on the outside of the covering.

The Market for Gas Securities.

The market for city gas shares was steady, in the face of the marked eccentricities displayed by the general share list of the Exchange. Consolidated is reported at noon to-day (Friday) at 147¾ to 148, which quotations show a slight net loss over the figures of last Friday. We have no hesitation in saying that Consolidated is a purchase for investment account. Mutual is positively buoyant, 195 being bid for it, and we doubt if an offer of 200 would bring out any stock. Equitable is 199 to 201. New York and East River is a trifle weaker, and Standard has held its own.

The Brooklyn consolidation terms have been accepted by a positive majority of the shareholders in the separate companies, and although some opposition was manifested, it was of sporadic rather than concentrated nature. The appearance of Counselor Jas. C. Church, representing interests adverse to the consolidation, at the meeting of one of the Companies, goes to show that some of the minority obstructionists are possibly of the class that made the bother for the Brooklyn City Railroad system. However, there is no doubt that the scheme will be enacted according to the programme. When the proper time comes we will give the details of the merger. In a small way it may be restated that the securities of the new Company are to be equal to $30,000,000 par—half bonds and half stock. All of the Brooklyn Companies are in the deal.

In out-of-town shares, Laclede showed a decline, as did Chicago gas, which opened weak and closed weak, selling down to 65. At that price Chicago looks to us to be a purchase, although one can hardly predict as to the course this football will take. Cincinnati gas sold up to 203⅝, and Baltimore is a trifle easier at 65 to 66½. Western, of Milwaukee, holds up well, at 68 to 70. Bay State is weak and dull, the ruling figures being 20¾ to 21. In the dissolution of the partnership of Close & Nash, Mr. Close continues on at 35 Wall street, Room 6, Mr. Nash occupying the office quarters of the old firm.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks.

35 WALL ST., NEW YORK CITY.

NOVEMBER 11.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	147¾	148
Central	500,000	50	150	..
" Scrip	220,000	..	100	..
Equitable	4,000,000	100	199	201
Bonds, 6's	1,000,000	1,000	106	..
" 1st Con. 5's	2,800,000	1,000	114	116
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	195	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	
Northern	150,000	50	79	80½
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	32½	24½
Preferred	2,000,000	100	62	64½
Bonds 1st 5's	3,500,000	1,000	99½	100½
" 1st Con. 5's	1,500,000	..	84	85½
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	70	72
Preferred	5,000,000	100	107½	109½
Bonds, 1st Mortgage, 5's	1,500,000	1,000	109	..
Yonkers	299,650	50	112	..
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	140	..
Citizens	1,200,000	20	70	..
" S. F. Bonds	330,000	1,000	..	101
Equity	2,000,000	10	..	..
" Bonds	1,000,000	..	..	..
Fulton-Municipal	3,000,000	100	220	..
" Bonds	300,000	..	103	..
Peoples	1,000,000	10	100	.
" Bonds, 7's	368,000	..	100	..
" " 6's	94,000	..	98	100
Metropolitan	870,000	100	200	..
" Bonds, 5's	70,000	..	..	..
Nassau	1,000,000	25	310	..
" Ctfs	700,000	1,000	99	100
Williamsburgh	1,000,000	50	310	..
" Bonds	1,000,000	..	107	110
Out-of-Town Companies.				
Bay State	5,000,000	50	20¾	21
" Income Bonds	2,000,000	1,000	27	30
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	81	82
2d " " "	3,000,000	1,000	56½	57
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	65⅜	65½
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	94	94¼
Columbus	1,069,000	..	66½	67
1st Mortgage	1,085,000	..	94	95
Consumers. Jersey City	2,000,000	100	91	94
" Bonds	600,000	1,000	100	..
Cincinnati G. & C. Co.	7,000,000	100	203	203½
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	.....	.	..	41
Consolidated, Baltimore	11,000,000	100	65	66½
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,400,000	..	..	..
Detroit	4,000,000	..	29½	30¼
" Con. Bonds	4,312,000	..	..	71
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	76½	78½
" Bonds	2,000,000	..	87	89
Hartford	750,000	25	130	135
Indianapolis	2,000,000	..	..	147x
" Bonds, 6's	2,650,000	..	103	105x
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	83	85
Bonds	1,000,000	1,000	86	88

Louisville	2,570,000	50	..	180
Laclede, St. Louis	7,500,000	100	23	23¼
Preferred	2,500,000	100	84	..
Bonds	9,084,400	1,000	94	90½
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co.	1,000,000	..	75	.
Bonds, 6's	4,000,000	..	120	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	46½	..
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.		25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	70½	71
St. Paul Gas Light Co.	1,500,000	100	68½	70
1st Mortgage, 6's	650,000	..	88	90
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	..	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	68	70
Bonds, 5's	3,556,000	..	94	95
Wilmington, Del.	500,000	50	188	190

Advertisers' Index.

GAS ENGINEERS.

Page

Jos. R. Thomas, New York City ... 804
Wm. Henry White, New York City ... 803
Fred. Bredel, Milwaukee, Wis. ... 799
H. C. Slaney, Brooklyn, N. Y. ... 803
Geo. R. Rowland, New York City ... 803
The Western Gas Construction Co., Fort Wayne, Ind. ... 794
Humphreys & Glasgow, New York City ... 790
T. G. Lansden, St. Louis, Mo. ... 803

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md. ... 801
United Gas Improvement Co., Phila., Pa. ... 798
Burdett Loomis, Hartford, Conn. ... 802
National Gas and Water Co., Chicago, Ills. ... 795
Economical Gas Apparatus Construct'n Co., Toronto, Ont 807
The Western Gas Construction Co., Fort Wayne, Ind. ... 794

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City ... 804
Continental Iron Works, Brooklyn, N. Y. ... 802
Deily & Fowler, Phila., Pa. ... 804
Kerr Murray Mfg. Co., Fort Wayne, Ind. ... 800
Stacey Mfg. Co., Cincinnati, Ohio. ... 803
Bartlett, Hayward & Co., Baltimore, Md. ... 801
Davis and Farnum Mfg. Co., Waltham, Mass. ... 800
R. D. Wood & Co., Phila., Pa. ... 802
Isbell-Porter Company, New York City ... 802
Fred. Bredel, Milwaukee, Wis. ... 799
United Gas Improvement Co., Phila., Pa. ... 798
Berlin Iron Bridge Co., East Berlin, Conn. ... 790
National Gas and Water Co., Chicago, Ills. ... 795
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 807
The Western Gas Construction Co., Fort Wayne, Ind. ... 794
Humphreys & Glasgow, New York City ... 790
Gas Engineering Co., Pittsburgh, Pa. ... 785

SCRUBBERS AND CONDENSERS.

G. Shepard Page's Sons, New York City ... 803
R. D. Wood & Co., Phila., Pa. ... 802
James R. Floyd & Sons, New York City ... 804
Continental Iron Works, Brooklyn, N. Y. ... 802
Gas Engineering Co., Pittsburgh, Pa. ... 785

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md. ... 801
Fred. Bredel, Milwaukee, Wis. ... 799
J. H. Gautier & Co., Jersey City, N. J. ... 799
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. ... 794
Adam Weber, New York City ... 794

TAR AND CARBONIC ACID EXTRACTOR.

G. Shepard Page's Sons, New York City ... 803

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich. ... 784
G. Shepard Page's Sons, New York City ... 803
Gas Engineering Co., Pittsburgh, Pa. ... 785

GAS METERS.

John J. Griffin & Co., Phila., Pa. ... 788
American Meter Co., New York and Philadelphia. ... 807
The Goodwin Meter Co., Phila., Pa. ... 806
Helme & McIlhenny, Phila., Pa. ... 807
D. McDonald & Co., Albany, N.Y. ... 807
Nathaniel Tufts, Boston, Mass. ... 806
Maryland Meter and Mfg. Co. Baltimore, Md. ... 806
Metric Metal Co., Erie, Pa ... 805
Keystone Meter Co., Royersford, Pa. ... 806

GAS AND WATER PIPES.

Ohio Pipe Co., Columbus, Ohio ... 805
M. J. Drummond, New York City ... 805
R. D. Wood & Co., Phila., Pa. ... 802
Warren Foundry and Machine Co., New York City ... 805
Donaldson Iron Co., Emaus, Pa. ... 805
Addyston Pipe and Steel Co., Cincinnati, O. ... 804

GAS BAGS.

Peerless Rubber Mfg. Co., New York City ... 785

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, New York City ... 799

GAS COALS.

Penn Gas Coal Co., Phila., Pa. ... 797
Perkins & Co., New York City ... 796
Despard Gas Coal Co., Baltimore, Md. ... 797
Westmoreland Coal Co., Phila., Pa. ... 797
Shaner Coal Co., Philadelphia, Pa. ... 785
Berwind-White Coal Mining Co., New York and Phila. ... 796
Henry C. Scheel, New York City ... 797

CANNEL COALS.

Perkins & Co., New York City ... 796
Log Mountain Coal, Coke and Timber Co., Pineville, Ky. 797
Henry C. Scheel, New York City ... 797

GAS ENRICHERS.

Standard Oil Co., New York City ... 797
The Sun Oil Co., Pittsburgh, Pa. ... 797
W. H. Townsend, New York City ... 797

COKE CRUSHER.

C. M. Keller, Columbus, Ind. ... 797

CONVEYING MACHINERY.

C. W. Hunt Company, N. Y. City ... 784

GAS GAUGES.

The Bristol Co., Waterbury, Conn ... 784

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City. 795
Isbell-Porter Co., New York City ... 802

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Company, New York City ... 802
Continental Iron Works, Brooklyn, N. Y. ... 802
G. Shepard Page's Sons, New York City ... 803

RETORTS AND FIREBRICK.

J. H. Gautier & Co., Jersey City, N. J. ... 798
B. Kreischer & Sons, New York City ... 798
Adam Weber, New York City ... 798
Laclede Firebrick Mfg. Co., St. Louis, Mo. ... 798
Cyrus Borgner, Phila., Pa. ... 798
James Gardner, Jr., Pittsburgh, Pa. ... 798
Henry Maurer & Son, New York City ... 798
Baltimore Retort and Firebrick Co., Baltimore, Md. ... 798
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. ... 798
Brooklyn Firebrick Works, Brooklyn, N. Y. ... 798
F. Behrend, New York City ... 785

CEMENTS.

C. L. Gerould & Co., Mount Vernon, N. Y. ... 798
F. Behrend, New York City ... 785

INCANDESCENT GAS LAMPS.

Welsbach Light Co., Gloucester, N. J. ... 787

MICA GOODS.

The Mica Mfg. Co., New York City ... 784

BURNERS.

C. A. Gefrorer, Phila., Pa. ... 802
George Bray & Co., Leeds, England ... 788

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn. ... 785

GAS TUBING.

New York Gas Tubing Co., New York City ... 785

STREET LAMPS.

J. G. Miner, Morrisania, New York City ... 799
Bartlett Lamp Mfg. Co., New York City ... 799

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 795
Greenpoint Chemical Works, Brooklyn, N. Y. ... 795
Henry W. Douglas, Ann Arbor, Mich. ... 795

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind. ... 792
Isbell-Porter Company, New York City ... 802
Connelly Iron Sponge and Governor Co., New York City 795

VALVES.

Ludlow Valve Manufacturing Co., Troy, N.Y. ... 794
Chapman Valve Manufacturing Co., Boston, Mass. ... 794
R. D. Wood & Co., Phila., Pa. ... 802
Continental Iron Works, Brooklyn, N. Y. ... 802
The P. H. & F. M. Roots Co., Connersville, Ind. ... 792
Isbell-Porter Co., New York City ... 802
The Western Gas Construction Co., Fort Wayne, Ind. ... 794

ELECTRICAL APPARATUS.

Wm. Henry White, New York City ... 803

GAS ENGINES.

Otto Gas Engine Works, Phila., Pa. ... 803
The American Gas Engine Co., Phila., Pa. ... 786

ENGINES AND BOILERS.

The Hazelton Boiler Company, New York City ... 784
W. G. & G. Greenfield, East Newark, N. J. ... 784

PURIFIER SCREENS.

John Cabot, New York City ... 785

GAS STOVES.

American Meter Co., New York and Philadelphia. ... 791
The Goodwin Meter Co., Phila., Pa. ... 806
George M. Clark & Co., Chicago, Ills. ... 789
Maryland Meter and Manufacturing Co., Baltimore, Md. 806
William M. Crane & Co., New York City ... 789
Keystone Meter Co., Royersford, Pa. ... 806
A. Weiskittel & Son, Baltimore, Md. ... 584
The Wolff Gas Radiator Mfg. Co., New York City. ... 787
Wilder Mfg. Co., Phila., Pa. ... 785

CHINA GAS KILNS.

F. A. Wilke, Richmond, Ind. ... 804
William M. Crane & Co., New York City ... 789

COIN WRAPPERS.

Alvord & Co., Detroit, Mich. ... 744

GASHOLDER PAINT.

The Government Waterproof Paint Co., Boston, Mass. ... 794
New York Marine Paint Co., Poughkeepsie, N.Y. ... 794

RED CEDAR TANKS.

Williams Mfg. Co., Kalamazoo, Mich. ... 784

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y. ... 799

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md. ... 801
Continental Iron Works, Brooklyn, N. Y. ... 802
Deily & Fowler, Philadelphia, Pa. ... 804
Davis & Farnum Mfg. Co., Waltham, Mass. ... 800
Kerr Murray Mfg. Co., Fort Wayne, Ind. ... 800
Stacey Mfg. Co., Cincinnati, Ohio. ... 803
R. D. Wood & Co., Philadelphia, Pa. ... 802

PATENTS.

H. B. Willson & Co., Washington, D. C. ... 785

WANTED,

An Agent to Push the Sale of Gas and Cannel Coal.

One having good connection among Gas Companies and Coal Merchants. Address, stating connection and experience,

1064-3 "X. Y. Z.," care this Journal.

Situation Wanted

By a practical man

To Take Charge of a Gas Works,

or to superintend the laying of mains, the running of services, the placing of meters, etc. Willing to begin on a moderate salary. Can furnish any reference required.

1065-2 Address "B. J.," care this Journal.

Position Solicited

As Engineer or Superintendent of Gas Works,

By graduate Mechanical Engineer of Stevens Institute of Technology, with seven years' experience and training in the responsible management of property at the Paterson (N. J.) Gas Works. Address PAUL A. DOTY, 257 Graham Av., 1034-tf Paterson, N. J.

POSITION WANTED

As Supt. or Manager of a Gas Works or Gas and Electric Light Works.

Fifteen years' experience as Manager of Gas Works and six years Gas and Electric Light Works. Good reasons for wishing to change present employment.

1043-tf Address "Y. B.," care this Journal.

WANTED,

By a man who has had a round experience in the manufacture and sale of gas,

A Position as Supt. of a Large or Small Gas Works.

Is capable and energetic, and is willing to begin at a moderate salary. Address

1062-tf "B.," care this Journal.

WANTED,

A Second-Hand Gas Engine of Some Standard Make,

that will develop from 8 to 10 horse power. Address, giving price and full particulars,

CAPITAL GAS AND ELECTRIC LT. CO.,

1065-6 Frankfort, Ky.

WANTED,

One or Two Purifying Boxes 8 ft. by 8 ft. or 8 ft. by 10 ft., with 8-in. Connections.

Give condition, with price.

THE VAN WERT GAS LT. CO.,

1064-4 Van Wert, Ohio.

FOR SALE,

Four Purifying Boxes, 8 ft. by 8 ft.,

with 6-inch Center Valves and Connections, in good order.

HOUSTON GAS LIGHT CO.,

1054-8 Houston, Texas.

Coal Tar For Sale.

PROPOSALS for the entire make of **TAR** in the works of the Pittsburgh Gas Company, for five years from the first day of January next, will be received at the Company's Office, No. 435 Sixth Avenue, Pittsburgh, Pa., until the 7th day of December, at noon. Bids to be by the net ton of 2,000 pounds of coal carbonized. Tar to be delivered in tank at our works. Right to use sufficient tar for Company's own purposes, and to reject any or all bids, reserved. Address bids to D. Herbert Hostetter, Prest.

1066-3 JOHN H. McELROY, Eng'r.

Proposals for Coal Tar.

The North Adams (Mass.) Gas Light Company invites Proposals for its annual output of Gas Tar, amounting to 600 barrels. The gas made on these works is strictly produced from the carbonization of the best gas coal, no oil being used even for enriching purposes.

1064-tf F. S. RICHARDSON, Treasurer.

Proposals for Coal Tar.

OFFICE LOUISVILLE GAS CO.,
LOUISVILLE, KY., Oct. 9, 1895.

Proposals will be received until noon of Nov. 15, 1895. for the Coal Tar produced at these works on a basis of one, three or five years. Particulars as to quantity, facilities, etc., may b had on application to the undersigned.

1062-5 A. H. BARRET.

Utilize Your Gas Liquor.

NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to

STROH & OSIUS, Pat'ees, or
Mich. Ammonia Works, Detroit, Mich.

Get Our Prices on

Mica Chimeys

For Welsbach Lights,

AND ON

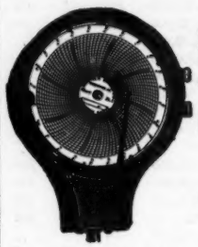
Mica Canopies.

The MICA MFG. CO.,

Micasmiths,

88 Fulton Street, - - New York City.

BRISTOL'S RECORDING **PRESSURE GAUGE**



For Continuous Records of

Street Gas Pressure.

Simple in Construction,
Accurate in Operation,
Low in Price,
Fully Guaranteed.

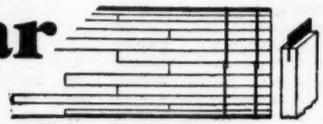
Send for Circulars.

THE BRISTOL CO.
Waterbury, Conn.

Received Medal at World's Columbian Exposition.

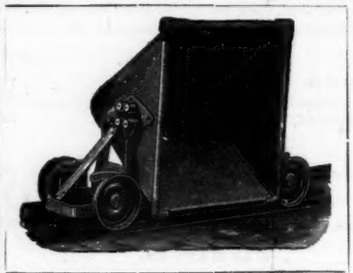
Red Cedar TANKS.

Cylinders and Caissons of PINE or CYPRESS. Any size.
WILLIAMS MFG. CO., Kalamazoo, Mich.



16 Murray St., New York.
737 Monadnock Bldg., Chicago.
36 S. Market St., Boston.
331 Vine St., Phila.

G. W. HUNT COMPANY.



THE HUNT TIP CAR.

COKE CARS for Gas Works,
TIP CARS for Carrying Ashes,
CHARGING CARS for Bringing Coal from the Storage Bins to Boiler Room and Retort Houses.

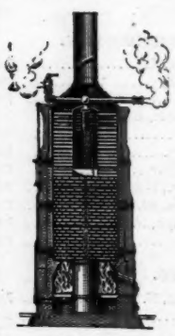
INDUSTRIAL RAILWAYS

Specially designed for handling material in and around

Gas Works, Coal Yards, Factories, Etc., Etc.

45 BROADWAY, - - NEW YORK.

THE HAZELTON OR PORCUPINE WATER TUBE BOILER.



The Best Boiler in the World, and the Cheapest per Square Foot of Heating Surface.

Unequaled for the Economical Production of Very Dry Steam.

WE GIVE Liberal Capacity, Highest Efficiency, Absolute Safety and Thorough Workmanship.

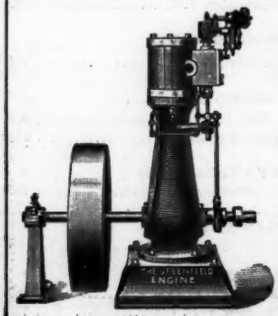
WE SOLICIT the Critical Examination of the Mechanical Profession and the Steam-Using Public, and Your Trade.

Send for Catalogue and Reports of Tests.

The HAZELTON BOILER COMPANY,

Sole Proprietors and Manufacturers,

Cable Address, "Paila," New York. Tele., "1229-18th St.," New York. Gen'l Office, 716 E. 13th St., N.Y., U.S.A.



GREENFIELD Steam Engine Works.

Established 1874.

MANUFACTURERS OF

Greenfield Stationary, Portable and Yacht

ENGINES AND BOILERS.

Also Horizontal, Automatic and Variable Cut-off Engines.

Sizes from 3 to 75 Horse Power.

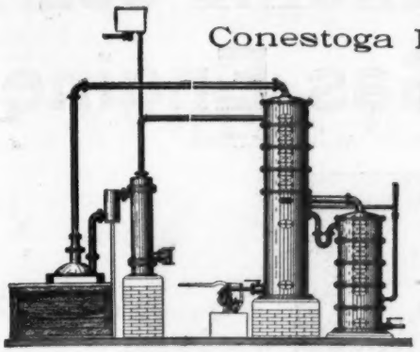
Also Vertical and Horizontal and Marine Boilers.
Steam Pumps and Adams' Crate Bars.

W. G. & G. GREENFIELD, - - EAST NEWARK, N. J.

GAS ENGINEERING COMPANY,

INCORPORATED,

Conestoga Building, PITTSBURGH, PA.



AMMONIA MACHINE.

MANUFACTURERS OF

Gas Works Machinery of all kinds,

PATENTEE AND OWNER OF

PITTSBURGH WASHER-SCRUBBER,

SOLE AGENT FOR

FELDMANN AMMONIA MACHINE,

For producing Sulphate, Aqua, Chloride and Concentrated Liquors.

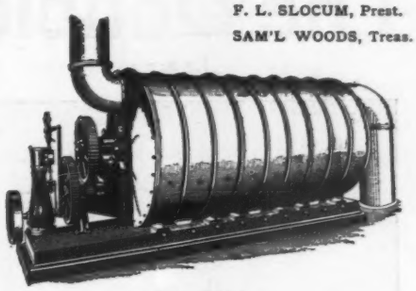
The Erection of Bi-Product Coke Ovens a Specialty.

Faux System of Recuperative Benches,

JAS. GARDNER, JR.
SOLE CONSTRUCTOR AND BUILDER.

NEW SYSTEM HYDRAULIC MAIN.

F. L. SLOCUM, Prest.
SAM'L WOODS, Treas.



SCRUBBER.

The Celebrated SHANER GAS COAL

CORRESPONDENCE SOLICITED.

Is Mined and Shipped from the Best Gas Coal Basin in Pennsylvania.

SHANER COAL CO., - 1326 Chestnut Street, Philadelphia.

If You Want the Best GAS-TIGHT Tubing,

BUY OF THE

NEW YORK GAS TUBING CO.

771-779 Greenwich St., N. Y.

GUARANTEED NOT TO STIFFEN. **Makers of All Kinds of Flexible Tubing.**

PATENTS

Promptly secured. Trade-Marks, Copyrights and Labels registered. Twenty-five years experience. We report whether patent can be secured or not, free of charge. Our fee not due until patent is allowed. 32 page Book Free. H. B. WILLSON & CO., Attorneys at Law, Opp. U. S. Pat. Office. WASHINGTON, D. C.

F. BEHREND,

SOLE IMPORTER OF THE CELEBRATED

German (Stettin-Didier) Clay Gas Retorts,

BLOCKS, TILES, FIREBRICKS, FIRE CEMENT,

Stettin "Anchor" & "Eagle" Brand Portland Cement

10 & 12 Old Slip, New York.

Special Trays for Iron Sponge or Oxide of Iron.

CHURCH'S TRAYS a Specialty.

Reversible, Strongest, Most Durable, Most Easily Repaired.

306-310 Eleventh Avenue, New York.

We also make the Cheapest and Strongest

REVERSIBLE BOLTED TRAYS IN THE MARKET

Send for Circulars.

Patent Lava Gas Tips.

UNIFORMITY GUARANTEED.

ALL SIZES AND SHAPES.

D. M. STEWARD MFG. CO.,

CHATTANOOGA, TENN.

TRIUMPH REGENERATIVE GAS HEATER

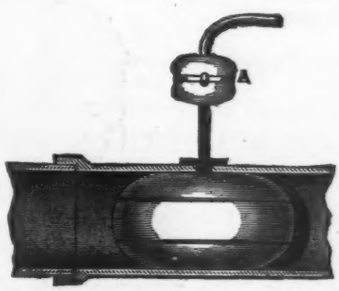
Wilder's Patents, Nov. 15 & 22, 1892.

Heats both air and gas before combustion. Gives high flame temperature and maximum economy, with entire freedom from smoke and smell. Radiates heat to the floor. Warms the feet and does not overheat the head. No headache and no colds caused by cold feet where this Heater is used. Has Group Governor, which regulates gas volumetrically proportionate to heat desired; the only correct regulation for stoves and furnaces. A gas heater, if a free gift, is still costly and extravagant if it burns gas wastefully. The Triumph Heater is constructed upon correct principles, and gives results not obtained with any other.

Write for descriptive circulars and order sample Heater.

WILDER MFG. CO., 816-822 Cherry St., Phila.

Peerless Patent Improved Gas Bag



These Gas Bags are used to stop the flow of gas while repairing or making alterations in gas mains. There have been numerous cases of workmen being badly injured, and sometimes fatally, by the escape of gas resulting from the bursting of a bag, and our patent improvement is designed to obviate such calamities. The indicator *A* shows unerringly when the bag has been sufficiently inflated to pack the main, and when the pumping should be stopped. Our Bags are made of a rubber stock especially prepared to admit of great distension, and to resist the action of Oils, Gases, Naphtha and other residuum in the mains, and they are made with lapped joints, which adds greatly to their strength.

3-in.	Gas Bag,	each,	$0.60	12-in.	Gas Bag,	each,	$5.00
4 "	"	"	.80	16 "	"	"	8.25
5 "	"	"	1.05	20 "	"	"	12.00
6 "	"	"	1.75	24 "	"	"	17.00
8 "	"	"	2.65	30 "	"	"	27.50
10 "	"	"	3.75				

The Peerless Rubber Mfg. Co.

16 Warren St., N. Y. City.

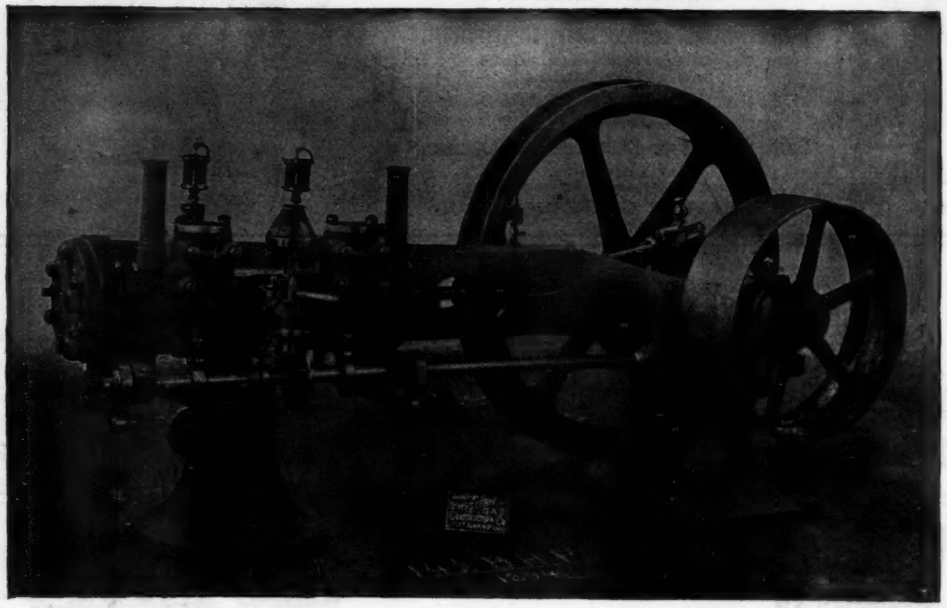
WM. W. GOODWIN, Prest. O. N. GULDLIN, V.-Prest. & Treas. H. B. GOODWIN, Sec. ERNEST F. LLOYD, Asst. Sec

THE AMERICAN GAS ENGINE CO.,

MANUFACTURERS OF

The Double-Acting Gas Engine,

Under the Patents of Griffin, and Dick, Kerr & Co., of London and Kilmarnock.



**

Single Cylinder.

Impulse Every Revolution.

(Two Strokes.)

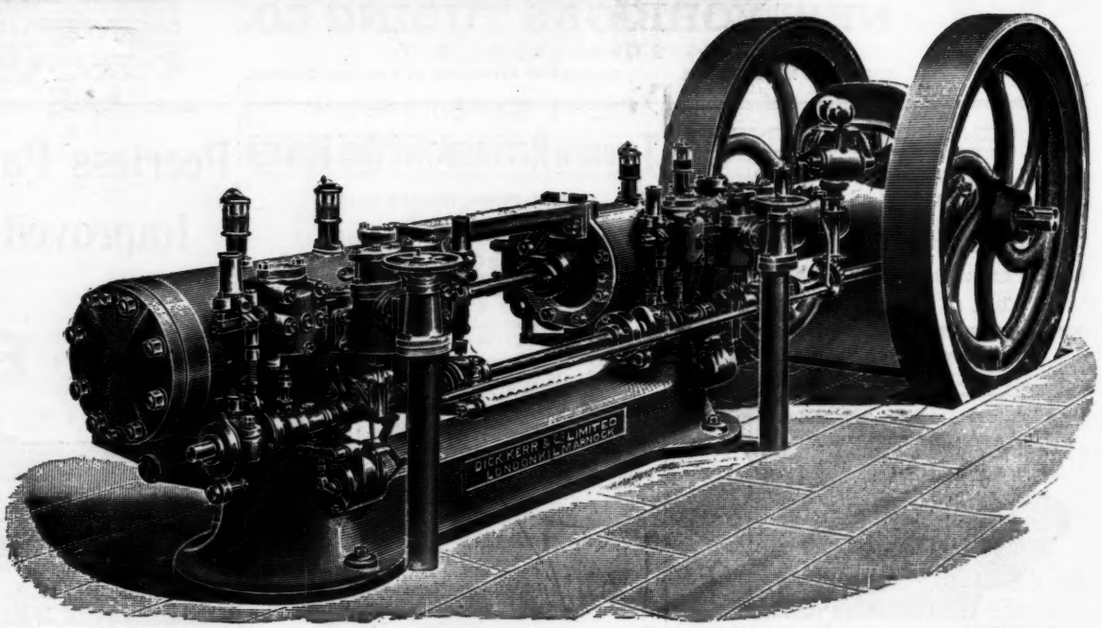
15 to 500 Horse Power.

For General Work and Isolated Electric Plants.

**

Tandem Cylinder. Impulse Every Stroke. 100 to 1,000 Horse Power.

For Central Stations and all work requiring extreme steadiness.

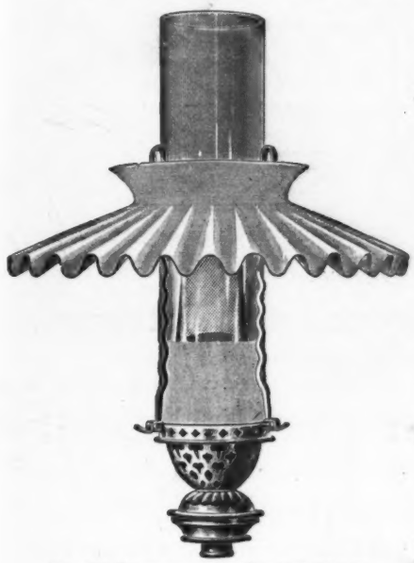


ESSENTIAL PRINCIPLE.—An impulse at each end of piston; using half force to each impulse; doubling the steadiness; reducing the wear on moving parts, and weight for given power. **CONSTRUCTION.**—The piston rod works through stuffing box in front end of cylinder, and connecting rod is carried in a cross-head working in a slide in frame, as in ordinary steam engine practice. All valves are of the poppet type, operated by cams on a single cam-shaft, giving positive movement to every working part. Tube or electric ignition. **RESULT.**—An engine of extreme simplicity and steadiness of action, the even wear on the cylinder and all working parts assuring increased economy, long life, and minimum cost in repairs. **RECORD.**—Successful and constant use in Great Britain for the past eight years. Address

W. W. GOODWIN, President, Lock Box 718, Philadelphia, Pa., or
THE WESTERN GAS CONSTRUCTION CO. Bldrs. & Gen. Agts., Fort Wayne Ind.

The Improved

Welsbach Light.



No. 31 Burner, with No. 74 Shade.

No. 31 Burner, with Nos. 10 and 43 Shades.

Made by the

Welsbach Light Company,

Gloucester City, N. J.

Sole Manufacturers for the United States.

The WOLFF Gas Radiator.

Size, 33 Inches High, 21 Inches Wide and 10 Inches Deep. The Trilby Heaters are furnished in Brass, Copper-Bronze and Nickel Plate.

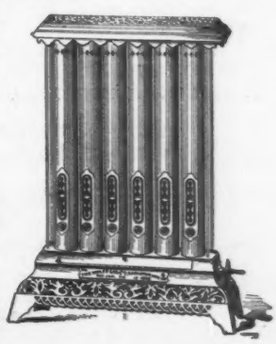
The Most Ornamental and Economical Gas Heater in the World.

The WOLFF Gas Radiators are no Longer an Experiment.

Heating with gas as a fuel instead of wood or coal was made practicable only four years ago, when the first WOLFF Gas Radiator was made. Since that time we have supplied Gas Radiators to heat all kinds of Rooms, Halls, Stores, Churches, Theaters, etc.; they are used in Bed Chambers, Sick Rooms, and wherever heat is required. And, because of their great success, several imitation Gas Radiators are offered, "said to be as good as Wolff's;" but none of them are as good. The WOLFF Radiator gives more and better quality of heat, at less cost, than any gas heater in the market.

In our Trilby Heater we again offer something **new, novel** and **good,** as well as beautiful and pleasing to the eye. Most Stoves, Heaters and Radiators in use heat the **top** of the room, leaving the **floor** cold (hence keep the head warm and the feet cold). Our Trilby Heater warms the floor first; then the heat rises gradually, warming the whole room comfortably, cold air being drawn in from the bottom (passing between the heated radiating flues) and thoroughly warmed before passing out at the top, while the gas, mixed with air, is burned in our "Patent Incandescent Iron Fires Burners," which greatly intensifies the heat, causing an extra amount of heat to be radiated, or thrown off onto the floor, while the products of combustion are carried up through radiating iron flues to the top of the Trilby Heater, and downwards and out through opening to flue or chimney pipe connection, making a current or outlet for burnt gas or impure air, thus causing perfect ventilation in the room.

The Trilby uses less gas and gives more and better heat than any other Gas Radiator in the market.



MANUFACTURED BY

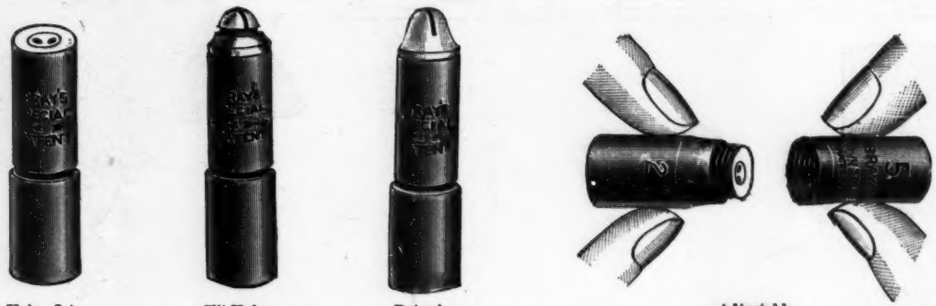
THE WOLFF GAS RADIATOR MANUFACTURING CO.,

Office, 164 Franklin St., New York.

Bray's Patent "Enamel" Gas Burners.

Bray's "Special" and "Adjustable" Burners

Are the Cheapest, Most Economical and Most Durable in existence, and will, at their REDUCED PRICE, save their cost in gas alone in forty hours' use.



Union Jet. Slit Union. Batswing. Adjustable.

Made with Inside Screw, to Suit American Fittings.

The "Specials" are made to suit Low and High Pressures. The "Adjustables" consist of two Burners screwed together, the sizes of which can be arranged to suit any Pressure and Consumption. For full description see Catalogue.

See that **"Bray's Special"** or **"Bray's Adjustable"** is stamped on each kind of Burner.

ACETYLENE AND RICH OIL GASES.—We now make Burners suitable for use with these Gases.

TO BE HAD OF DEALERS THROUGHOUT THE STATES.

IN NEW YORK: E. P. Gleason Mfg. Co., 181 to 189 Mercer St. Consolidated Gas Co. of New York, 4 Irving Place.

IN BOSTON, MASS.: Waldo Brothers, 88 Water Street.

SCIENTIFIC BOOKS.

GAS MANUFACTURE, by William Richards. 4to., with numerous Engravings and Plates, in Cloth binding. $12.

TECHNICAL GAS ANALYSIS. $3.

GAS CONSUMER'S GUIDE. $1.

GAS CONSUMER'S HANDYBOOK, by Wm. Richards, C.E. 20 cents.

PRACTICAL TREATISE ON HEAT AND VENTILATION, with Special Relation to Illuminating, Heating and Cooking by Gas. By E. E. Perkins. $1.25,

CHEMISTRY OF ILLUMINATING GAS. By Norton H. Humphrys. $2.40.

PRACTICAL TREATISE ON HEAT. By Thomas Box. 2d edition. $5.

PRACTICAL PHOTOMETRY: A Guide to the Study of the Measurement of Light. By W. J. Dibdin. $3.

CHEMICAL TECHNOLOGY. $7.

IRONWORK: Practical Designing of Structural Ironwork. By H. Adams. $3.50.

GAS WORKS: Their Arrangement, Construction, Plant and Machinery. $5.

COAL: Its History and Use. By Prof. Thorpe. $3.50.

THE GAS WORKS OF LONDON. By Colburn. 60 cents.

HEAT A MODE OF MOTION. By John Tyndall. $2.50.

THE MANAGEMENT OF SMALL GAS WORKS. By C. J. R. Humphreys. $1.

MANUAL FOR GAS ENGINEERING STUDENTS. By D. Lee. 40 cents.

THEORY OF HEAT. By J. Clerk-Maxwell. $1.50.

AMMONIA AND AMMONIUM COMPOUNDS. By Dr. R. Arnold. $2.

DIGEST OF GAS LAW. $5.

DISTILLATION OF COAL TAR AND AMMONIACAL LIQUOR. By Geo. Lunge. New edition. $12.50.

A TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS. By D. A. Graham. $3.

THE AMERICAN GAS ENGINEER AND SUPERINTENDENT'S HANDBOOK. By William Mooney. $3.

A TEXT BOOK OF INORGANIC CHEMISTRY. By Prof. Victor Von Richter. $2.

ILLUMINATING AND HEATING GAS. By W. Burns. $1.50

HANDBOOK FOR MECHANICAL ENGINEERS. By H. Adams. $2.50.

FUEL AND ITS APPLICATIONS. $7.50.

TREATISE ON MASONRY CONSTRUCTION. Baker. $5.

GAS ENGINEER'S LABORATORY HANDBOOK. By Jno. Hornby, F.I.C. $3.50.

GAS LIGHTING AND GAS FITTING. By W. P. Gerhard. 50 cents.

AMERICAN PLUMBING. By Alfred Revill. $2.

CEMENT: A Manual of Lime and Cement, their Treatment and Use in Construction. By A. H. Heath. $2.50.

ELECTRICITY.

ELEMENTS OF ELECTRIC LIGHTING, Including Electric Generation, Measurement, Storage and Distribution. By Philip Atkinson. $1.50.

ELECTRIC TRANSMISSION OF ENERGY. By G. Knapp. $3.

ELECTRICIAN'S POCKETBOOK. By Monroe and Jamieson. $2.50.

MAGNETISM AND ELECTRICITY. By J. Overend. 40 cts.

ACCUMULATORS. By Sir D. Solomons. $1.50.

DYNAMO BUILDING. By F. W. Walker. 50 cents.

DOMESTIC ELECTRICITY FOR AMATEURS. By E. Hospitalier. $2.50.

PRACTICAL MANAGEMENT OF DYNAMOS AND MOTORS. $1.

PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES. $1.

ELECTRIC LIGHT FITTING. $2.

PRACTICAL ELECTRICITY. $2.50.

ELECTRICITY FOR ENGINEERS. $2.50.

The above will be forwarded by express, upon receipt of price. If sent by mail, postage must be added to above prices. We take especial pains in securing and forwarding any other Works that may be desired, upon receipt of order. All remittances should be made by check, draft, or post office money order.

A. M. CALLENDER & CO., 32 Pine Street, New York.

Jewel Gas Heaters and Radiators.

54 Styles. From $4 to $30.

The Finest and Largest Line in the World . . . .

Many New Designs.

It Will Pay You to Have the Jewel Catalog.

GEORGE M. CLARK & COMPANY,

MAKERS,

149-161 Superior Street, Chicago.

Eastern Agency, 152-154 West 23d Street, N. Y. City.

WILLIAM M. CRANE & CO.

Office, 838 Broadway; Factory, 428 & 430 W. 14th St., NEW YORK CITY.

SEND FOR NEW CATALOGUE.

We Carry the Most Complete Line of Gas Appliances in the Country.

Gas Fires, Gas Logs, Fire Place Heaters, Ranges, Broilers, Laundry Stoves,

ASBESTOS FIREPLACE HEATER.

SEND FOR NEW CATALOGUE.

Tailor Stoves, Soldering Furnaces, Griddles, Waffle Stoves, Hot Plates, Gas Kilns, etc., etc.

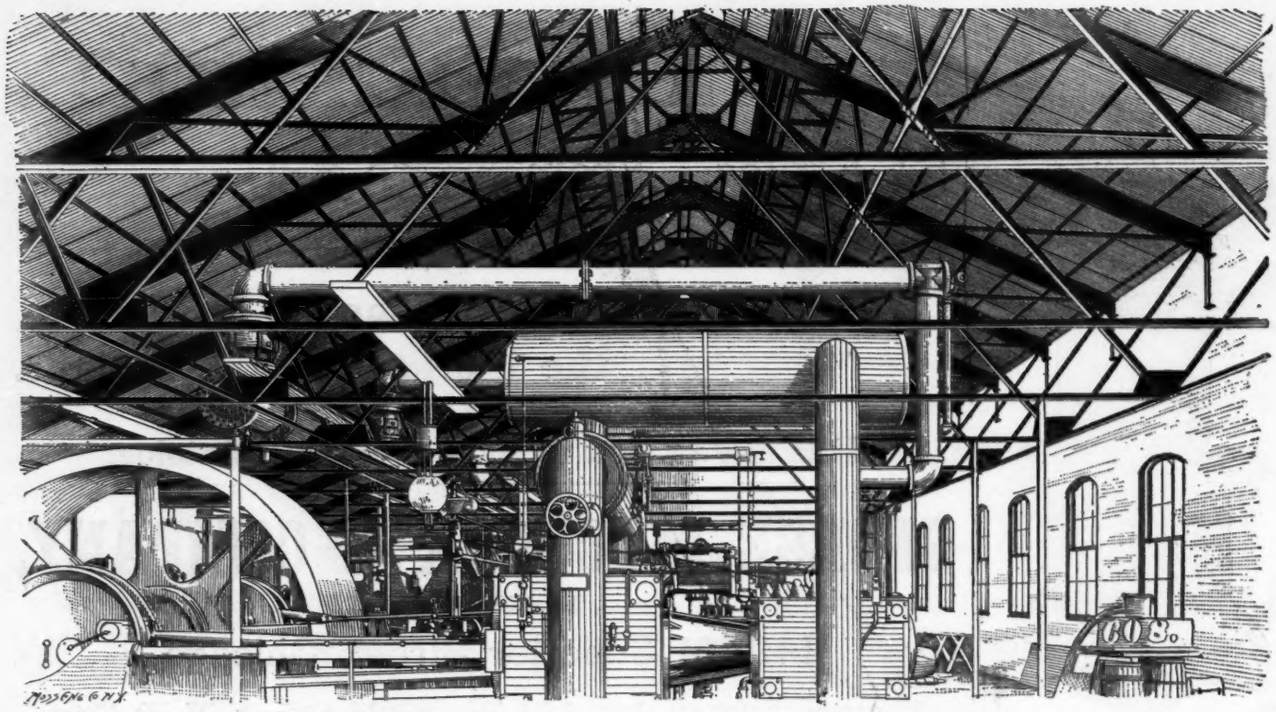
A New Line of Radiators.

The "Vulcan" Asbestos Fireplace Heaters

With Cirbulating Hot Air Chamber. 25.5 x 31 and 31 x 31. This is not a cheap Fire, but substantially made, handsomely finished, and guaranteed to give entire satisfaction.

CHAS. M. JARVIS, Prest. & Chief Engineer. BURR K. FIELD, Vice-President. FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary.

THE BERLIN IRON BRIDGE CO.



The above illustration is taken from a photograph, and shows an interior view of the Engine Room for the Narragansett Electric Lighting Co. at Providence, R. I. This plant is probably one of the best electric lighting plants in the United States. The Roofs of the entire plant were designed and built by us of iron, covered with our Patent Anti-Condensation Corrugated Iron Roof Covering, guaranteed as absolutely fireproof; and we further guarantee that the Corrugated Iron will not drip in the coldest weather.

Write for Illustrated Catalogue.

Office and Works, No. 6 Railroad Avenue, East Berlin, Conn.

ALEX. C. HUMPHREYS, M.E.,
MANHATTAN LIFE BUILDING,
(64 BROADWAY,)
NEW YORK.

CABLE ADDRESS,
LONDON & NEW YORK,
"HUMGLAS."

ARTHUR G. GLASGOW, M.E.,
9 VICTORIA ST.,
LONDON, S. W.,
ENGLAND.

HUMPHREYS & GLASGOW,

CONTRACTING AND CONSULTING

GAS ENGINEERS.

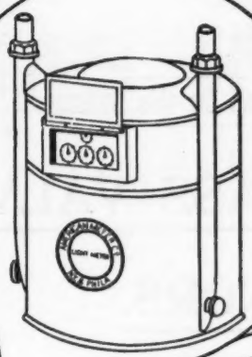
WATER GAS PLANT A SPECIALTY.
GAS PROPERTIES EXAMINED AND VALUED.
ADVICE AS TO IMPROVEMENT OF GAS PROPERTIES AND MANAGEMENT.

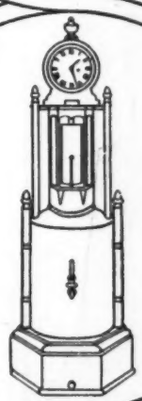
THE MANAGEMENT OF SMALL GAS WORKS.

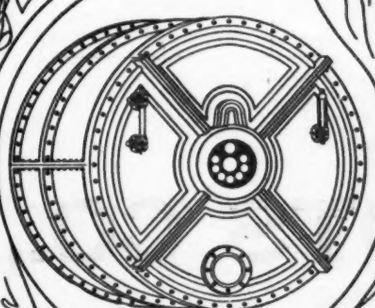
By C. J. R. HUMPHREYS.

Price $1.

A. M. CALLENDER & CO., No. 32 Pine Street New York.







(Copyrighted, 1894, by the AMERICAN METER CO.)

AMERICAN METER CO.

ESTABLISHED 1834. INCORPORATED 1863.

NEW YORK AND PHILADELPHIA,
CHICAGO, ST LOUIS,
SAN FRANCISCO.

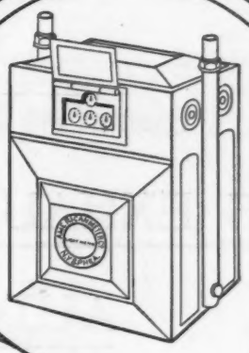
PUBLIC LIGHTING TABLE.

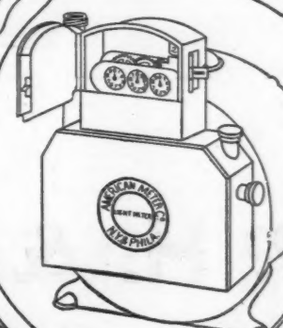
NOVEMBER, 1895.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. Extinguish.
				P.M.	A.M.
Fri.	1	No L.	No L.	4.45	5.35
Sat.	2	No L. FM	No L.	4.45	5.35
Sun.	3	No L.	No L.	4.45	5.35
Mon.	4	5 20 PM	6.50 PM	4.45	5.35
Tue.	5	5.20	7.40	4.40	5.45
Wed.	6	5.20	8.40	4.40	5.45
Thu.	7	5.20	9 50	4.40	5.45
Fri.	8	5.20	11.00	4.40	5.45
Sat.	9	5.20 LQ	12.20 AM	4.40	5.45
Sun.	10	5.20	1.30	4.40	5.45
Mon.	11	5.20	2.50	4.40	5.45
Tue.	12	5.20	4.00	4.30	6.00
Wed.	13	5.20	5.50	4.30	6.00
Thu.	14	5.20	5.50	4.30	6.00
Fri.	15	5.20	5 50	4.30	6 00
Sat.	16	5.20 NM	5.50	4.30	6.00
Sun.	17	5.10	5.50	4.30	6.00
Mon.	18	5.10	5.50	4.30	6.00
Tue.	19	5.10	5.50	4.25	6.00
Wed.	20	5.10	5.50	4.25	6.00
Thu.	21	8.10	5.50	4.25	6.00
Fri.	22	9.10	5.50	4.25	6.00
Sat.	23	10.20 FQ	5.50	4.25	6.00
Sun.	24	11.20	6.00	4.25	6.00
Mon.	25	12.20 AM	6.00	4.25	6.00
Tue.	26	1.10	6.00	4.20	6.10
Wed.	27	2.20	6.00	4.20	6.10
Thu.	28	3.20	6.00	4.20	6.10
Fri.	29	4.30	6.00	4.20	6.10
Sat.	30	No L.	No L.	4.20	6.10

TOTAL HOURS LIGHTING DURING 1895.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	237.00	January	423.20
February	196.40	February	355.25
March	195.50	March	355.35
April	165.30	April	298.50
May	153.40	May	264.50
June	138.20	June	234.25
July	146.30	July	243.45
August	152.50	August	280.25
September	165.10	September	321.15
October	186.10	October	374.30
November	204.10	November	401.40
December	219.30	December	433.45
Total, yr.	2161.20	Total, yr.	3987.45





P. H. & F. M. ROOTS CO.,

Connersville, Ind.

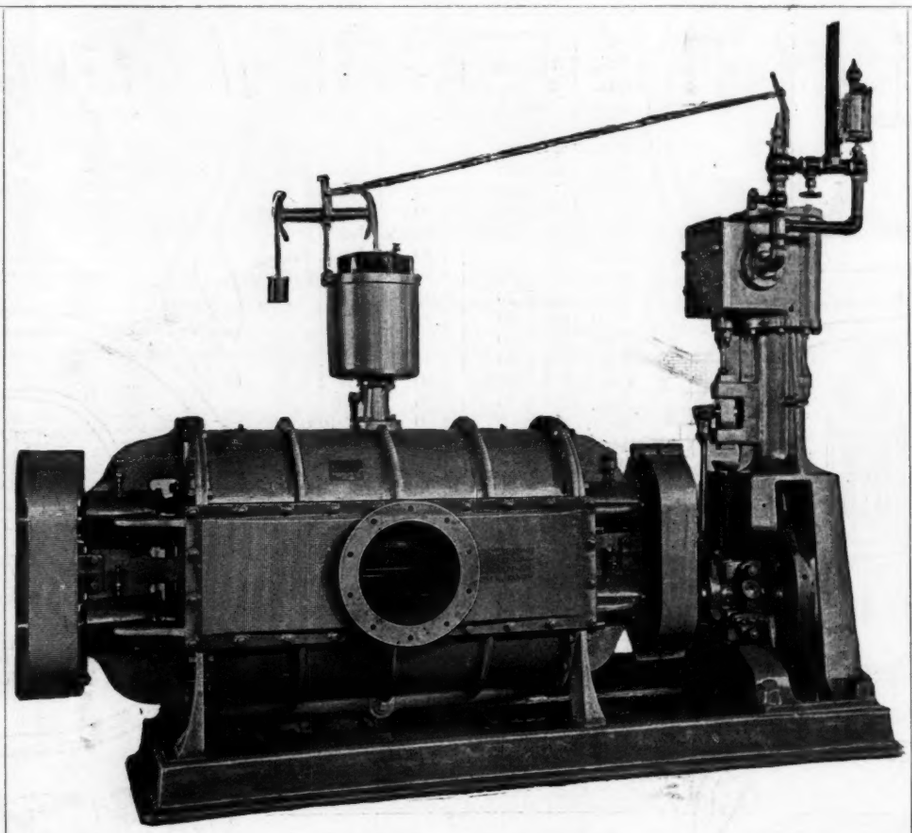
Exhausters with Combined Capacity of 65,000,000 Feet per Day Sold so far this Season.

GAS EXHAUSTERS. BYE-PASS VALVES.

AUTOMATIC GAS GOVERNORS.

GAS VALVES. PIPE FITTINGS.

New Design of Direct Connected Engine and Exhauster on Same Bedplate.



This Design is Used for all Exhausters from No. 7 to No. 10, Inclusive.

Write for Illustrated Catalogue.
Estimates submitted on application.

P. H. & F. M. ROOTS CO.,

Connersville, Indiana.

COOKE & CO., Selling Agts., 163-165 Washington St., N. Y. City.

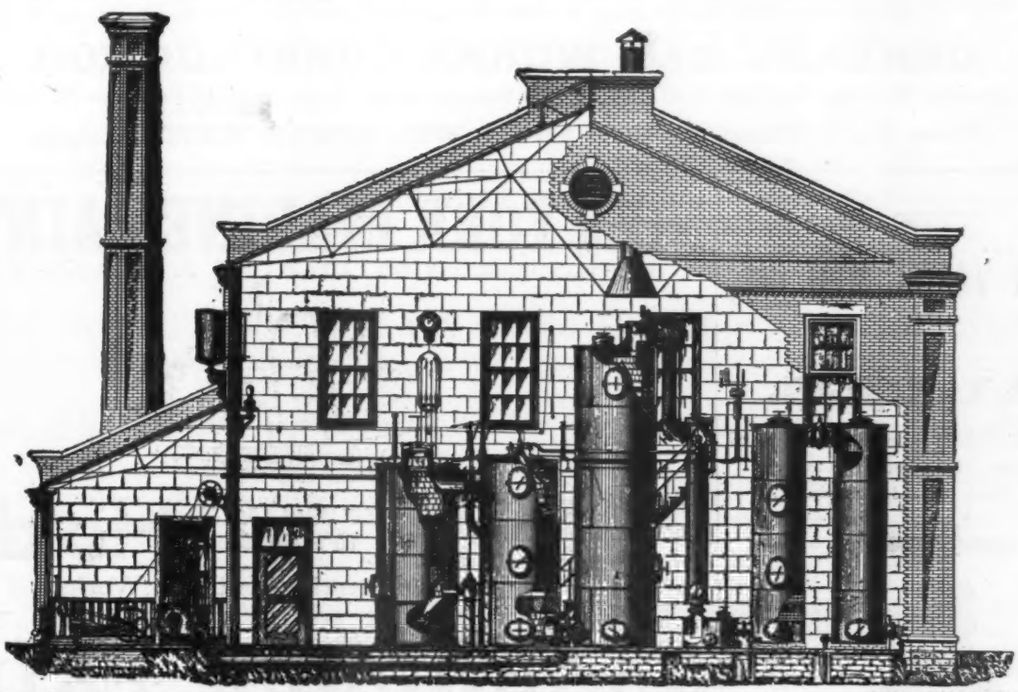
THE UNITED GAS IMPROVEMENT CO.,

DREXEL BUILDING, PHILA., PA.

Inquiries from any part of the United States should be addressed to the Philadelphia Office.

BUILDERS OF

THE STANDARD LOWE WATER GAS APPARATUS.



Standard "Double Superheater" Lowe Apparatus, designed for the use of Naphtha, Crude Oil, or "Distillates."

BUILDERS, LESSEES AND PURCHASERS OF GAS WORKS.

Water Gas Plants, either independent or auxiliary to Coal Gas Works, erected to meet any conditions. Apparatus designed to use any grade of Oil, and Anthracite Coal, or Gas House or Oven Coke.

PAMPHLETS, PLANS AND ESTIMATES FURNISHED UPON APPLICATION.

THE WESTERN
GAS CONSTRUCTION CO.,

ENGINEERS and BUILDERS,

FORT WAYNE, INDIANA.

IMPROVED LOWE WATER GAS APPARATUS.

Special No. 1 Setting, for Small Works.

Standard Setting, Carbureter and Superheater combined in one shell, with independent blasts. All capacities.

Double Superheater Setting. Separate Carbureter and Superheater.

Improved Double Superheater Setting, having a Vaporizing Chamber in the Top of the Carbureter (Patented Nov. 13th, 1894). This IMPROVED SETTING can be applied to the ordinary Settings now in use.

All settings (except No. 1) are built with or without our Ball Valve Connection for "up and down runs." Our Apparatus will use any grades of Oils or Naphthas, Gas House or Oven Coke, and Anthracite Coal. Results guaranteed.

GENERAL GAS WORKS CONSTRUCTION.

Purifiers, Holders, Coal Gas Benches, Hub and Flange Valves, Street Main Specials, Condensers, Scrubbers, Etc.

New York Office, 32 Pine Street, WM. HENRY WHITE, Engr.

THE

LUDLOW VALVE MFG. CO.,

MANUFACTURERS OF

VALVES,

Double and Single Gate, ¼ in. to 72 in., outside and inside Screws. Indicator, etc., for Gas, Water, Steam, Oil and Ammonia.

SEND FOR CIRCULAR.

SEND FOR CIRCULAR.

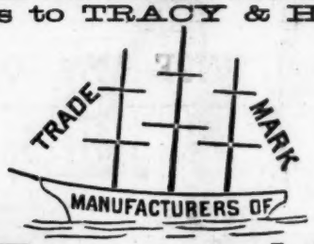
ALSO,

Hydraulic Main Dip Regulators, Check Valves, Foot Valves, Yard Wash and Fire Hydrants.

OFFICE AND WORKS:
938 to 954 River St., & 67 to 83 Vail Av.
TROY, N Y.

NEW YORK MARINE PAINT CO.

Successors to TRACY & HADDEN.



PAINT PECULIARLY ADAPTED TO STAND ON Holders

And all Ironwork about Gas Works.

POUGHKEEPSIE, N. Y.

GASHOLDER PAINT.

Use Only

THE GOVERNMENT WATERPROOF PAINT.

Proof against Ammonia, and Absolutely Waterproof. Send for Prices and Particulars.

THE GOVERNMENT WATERPROOF PAINT CO. 104 High Street, Boston, Mass.

CHAPMAN VALVE MANUFACTURING CO.,

MANUFACTURERS OF

Valves and Gates for Gas, Ammonia, Water, Etc.

Also, Gate Fire Hydrants with and without Independen Nozzle Valve. All Work Guaranteed.

Works & Gen'l Office, Indian Orchard, Mass, Treasurer's Office, 72 Kilby & 112 Milk Sts., Boston Mass
Chicago Office, 24 West Lake St. New York Office, 28 Platt St.
St. Louis Office, L. M. Rumsey Mfg. Co., 810 North Second St

NATIONAL GAS AND WATER CO.,

218 La Salle Street, Chicago.

Builder and Operator of Gas Works.

The Rew Soft Coal Carbureted Water Gas Apparatus.

TESTED BY TWO YEARS' PRACTICAL OPERATION, AND FULLY GUARANTEED.

Plans and Estimates Upon Application.

IRWIN REW, President & Treasurer. N. A. McCLARY, Secretary & Gen'l Manager. E. E. MORRELL, Engineer.

CONNELLY IRON SPONGE AND GOVERNOR CO.,

(Successors to CONNELLY & CO.)

MANUFACTURERS OF GAS WORKS SPECIALTIES.

"IRON SPONGE." Saves money, saves labor, and is the most efficient purifying material ever offered as a substitute for lime. We guarantee a large saving, both in cost of material and labor.

AUTOMATIC GOVERNOR. OVER FOUR HUNDRED NOW IN USE! NO WORKS COMPLETE WITHOUT IT! WILL PAY FOR ITSELF WITHIN A YEAR! ITS SERVICE SECURES PERFECT DISTRIBUTION! REDUCES LEAKAGE TO MINIMUM, and BENEFITS THE COMPANY and CONSUMER ALIKE! IT IS THE ONLY RECOGNIZED AUTOMATIC GOVERNOR IN THE WORLD!

STEAM JET EXHAUSTER. Designed particularly for small works. Combines Exhaust Tube, Steam Governor, Gas Compensator and Bye-Pass Valves in the most compact form possible. Occupies but little space; uses very little steam; saves formation of carbon in retorts; increases yield 10 to 15 per cent. No works too small to use them profitably.

Prices given on all our specialties, delivered at any point in the United States. Correspondence solicited.

CONNELLY IRON SPONGE AND GOVERNOR CO., No. 365 Canal St., New York.

Practical Photometry.

A GUIDE TO THE STUDY OF THE MEASUREMENT OF LIGHT.

By William Joseph Dibdin.

Price, $3.00.

A. M. CALLENDER & CO.,
32 Pine Street, N. Y. City.

DOUGLAS' FERRIC OXIDE

For Gas Purification

Is a superior natural Hydrated Oxide of Iron. Will give a higher purification per bushel than any other material. We ship the pure Oxide of Iron, containing no sawdust, thus effecting a saving in freight, leaving the consumer to furnish the diluent at a nominal cost. It is now used by the largest gas companies in the West.

Full information, with references to many users, and prices delivered in any locality, furnished on application to

H.W. Douglas (Supt. Ann Arbor Gas Company) **Ann Arbor, Mich.**

IRON MASS

For Gas Purification.

Acts immediately, and more efficiently than any other purifying agent now in use.

Greenpoint Chemical Works.

JOHN SCHRIEVER, Manager.

Greenpoint Ave. & Newtown Creek, Brooklyn N.Y

BOOKS.

DISTILLATION OF COAL TAR AN. AMMONIACAL LIQUOR.
By George Lunge. Price $12.50.

A TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS.
By David A. Graham. 8vo., Cloth. Price $3.

Orders for these books may be sent to this office.

A. M. CALLENDER & CO.,
32 Pine St., N. Y. City

The American Gas Engineer and Superintendent's Handbook.

By WM. MOONEY.

850 Pages, Full Gilt Morocco. Price. $8.00.

A. M. CALLENDER & CO., 32 Pine St., N. Y.

JAMES D. PERKINS. **PERKINS & CO.,** F. SEAVERNS.

228 and 229 Produce Exchange, New York City.

TIDEWATER SALES AGENTS FOR THE FOLLOWING

Standard Gas Coals and Cannel.

Ocean Mine Youghiogheny Gas Coal,

From Baltimore.

Clinch Valley, Thacker & Logan Gas Coals

From Norfolk, Va.

Old Kentucky Shale and O. K. Boghead,

From Kentucky,

The Most Valuable Enricher Now Obtainable.

Second Only to the Celebrated Australian Shale.

Cargo Shipments from New York, Philadelphia, Baltimore and Norfolk.

Single carloads or more delivered at any required point in the United States or Canada.

BERWIND-WHITE COAL MINING COMPANY'S

Ocean Westmoreland Gas Coal.

Offices:

55 Broadway, New York.

Betz Building, Philadelphia.

STRICTLY High Grade. . . . .
Carefully prepared.
For Gas Making or
Heavy Steaming.

Coal Tar Genealogical Tree

MR. T. VINER CLARKE, of London, Eng., having compiled a novel Chart or Map illustrating the various

CHEMICAL PRODUCTS DERIVED FROM COAL AND COAL TAR,

In the form of a Genealogical Tree, including all the products discovered to date (the total number amounting to near 700), offers for sale a limited number of copies in Colors, mounted on Linen, with Rollers. Price, $3.50. Orders may be sent to

A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.

GAS ENRICHERS. GAS COALS. GAS COALS.

The Despard Gas Coal Co.,

MINERS AND SHIPPERS OF

DESPARD GAS COAL,

AND MANUFACTURERS OF

COKE.

MINES, - - Clarksburgh, Harrison Co., West Va.
WHARVES, - - - Locust Point, Baltimore, Md.
OFFICE, - - - 44 South Street, Baltimore, Md.

ROUSSEL & HICKS, 71 Broadway, N. Y. } AGENTS, { BANGS & HORTON 60 Congress St., Boston.

ENRICH YOUR GAS

WITH OUR

"BEAR CREEK" CANNEL

Containing

14,630 Cu. Ft. of 41-Candle Gas and 995 lbs. of good Coke per ton of 2,240 lbs.

Log Mountain Coal, Coke & Timber Co.,

PINEVILLE, KY.

MACFARLANE & CO., Louisville, Ky., Agts. for U.S. and Canada.

HENRY G. SCHEEL,

Tidewater Sales Agent and Shipper of High Grade Westmoreland Vein, Youghiogheny, and West Virginia

Thoroughly Screened

GAS COALS.

Superior Kentucky Gas Cannel, Connellsville and Mountain Coke, Clearfield and Cumberland Vein Steam and Smithing Coals.

Room 176, Washington Building, No. 1 Broadway, N. Y. City.

KELLER ADJUSTABLE COKE CRUSHER.

Strong, Simple, Durable. Will Crush any Size Desired.

C. M. KELLER,
Sec. & Supt. Gas Lt. & Coke Co.,
Columbus, Ind.
Correspondence Solicited.

WILBUR H. TOWNSEND,

BROKER AND DEALER IN

Naphthas, Gas and Fuel Oils and Crude Petroleum for Gas Companies.

Room 115. 29 Broadway, N.Y. City.

— THE —

PENN GAS COAL CO.

OFFER THEIR

Coal, Carefully Screened and Prepared for Gas Purposes.

Their property is located in the Youghiogheny Coal Basin, near Irwin and Penn Stations on the Pennsylvania Railroad, and on the Youghiogheny River.

Principal Office:

Room 720, Reading Terminal Building, Phila., Pa.

Points of Shipment:

Pennsylvania Railroad Piers; Greenwich Wharves, Delaware River; Pier No. 1 (Lower Side), South Amboy, N. J.

EDMUND H. MCCULLOUGH, Prest. CHAS. F. GODSHALL, Treas. H. C. ADAMS, Sec.

THE WESTMORELAND COAL CO.

Chartered 1854.

Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Pa.

POINTS OF SHIPMENT:

PHILADELPHIA, BALTIMORE, SOUTH AMBOY, N. J., WATKINS (SENECA LAKE), N. Y.

Since the commencement of operations by this Company its well-known Coal has been largely used by the Gas Companies of New England and the Middle States, and its character is established as having no superior in gas-giving qualities, and in freedom from sulphur and other impurities.

Principal Office, 224 South 3d St., Phila., Pa.

THE SUN OIL CO.,

OHIO CRUDE OIL,

38 to 41 Degrees Gravity.

Toledo, O., and Pittsburgh, Pa.

Standard Oil Company,

GAS NAPTHA DEPARTMENT.

GAS NAPTHA.

GAS OIL.

Correspondence Solicited.

26 Broadway, New York City.

RETORTS AND FIRE BRICK. RETORTS AND FIRE BRICK. RETORTS AND FIRE BRICK.

J.H. GAUTIER & COMPANY
CORNER OF
GREENE AND ESSEX STREETS,
JERSEY CITY, N. J.
MANUFACTURERS OF
Clay Gas Retorts,
Gas House Tiles,
Fire Bricks, Etc. Etc.
Ground Clay, Fire Brick and Fire Sand in Barrels,
H. GAUTIER, Prest. CHAS. E. GREGORY, Vice-Prest.
DAVID R. DALY, Sec. & Treas., Gen'l Mangr.

Brooklyn Fire Brick Works,
MANUFACTURERS OF
CLAY RETORTS, FIRE BRICK,
Gas House and other Tile.
Office, 88 Van Dyke St., Brooklyn, N. Y.

LACLEDE FIRE BRICK MFG. CO.,
MANUFACTURERS OF
Fire Brick, Gas Retorts,
AND
ST. LOUIS STANDARD SEWER PIPE.
Blast Furnace and Cupola Linings, every description of Fire Clay Material, Fire Clay Flue Linings, Chimney Tops Dry Milled and Crude Fire Clays, etc.
OFFICE AND DEPOT
901, 903, and 905 Pine Street
ST. LOUIS, MO.

ESTABLISHED IN 1845.
B. KREISCHER & SONS,
OFFICE FOOT OF HOUSTON ST., E.R., N.Y.
Gas Retorts,
TILES, FIRE BRICK.
AND EVERYTHING IN THE FIRE CLAY LINE.

ADAM WEBER, Proprietor.
Manhattan Fire Brick and Enameled Clay Retort Works.
Works, Weber, N. J.
Office, 633 East 15th St., New York.
Modern Recuperative Furnaces
AND
Standard Fire Brick and Gas Retorts.

Works,
LOCKPORT STATION, PA.
—ESTABLISHED 1864.—
JAMES GARDNER, JR.,
Successor to WILLIAM GARDNER & SON.
Conestoga Bldg., Wood & Water Sts
PITTSBURGH, PA. P. O. Box 373.
Fire Clay Goods for Gas Works.
SOLE REPRESENTATIVE OF THE McILHENNY REGENERATIVE BENCHES FOR THE U. S.

HENRY MAURER & SON,
(ESTABLISHED 1856.)
EXCELSIOR FIRE BRICK & CLAY
RETORT WORKS
WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y.
Clay Gas Retorts,
BENCH SETTINGS,
Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT.
A cement of great value for patching retorts, putting on mouth-pieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.
PRICE LIST.
In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "
C. L. GEROULD & CO.,
N. 3d & Prospect Avs., Mt. Vernon, N.Y.
Western Agent, H. T. GEROULD, Centralia, Ills.

Parker-Russell Mining and Mfg. Co.,
CITY OFFICE,
Mermod-Jaccard Building, St. Louis, Mo.
PROPRIETORS OF THE
OAKHILL GAS RETORT & FIRE BRICK W'KS
Our immense establishment is now employed almost entirely in the manufacture of
Materials for Gas Companies
We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We construct
Half and Full Depth Benches of Our Own Design,
Containing 6, 8 or 9 Retorts.
We have Greatly Improved our Recuperators. Coal or Coke can be used as Fuel in Furnaces.

THOS. SMITH, Prest. AUGUST LAMBLA, Vice-Prest. & Supt
BALTIMORE RETORT & FIRE BRICK CO.
MANUFACTORY AT
LOCUST POINT BALTIMORE MD.
Clay Retorts, Blocks & Tiles
FIRE BRICK, FIRE CLAY,
AND FIRE CEMENT.
Red and Buff Ornamental Tiles and Chimney Tops. Baker Oven Tiles 12x12x2 and 16x16x2.
WALDO BROS., 88 WATER ST., BOSTON, MASS
Sole Agents for New England States.

King's Treatise on Coal Gas. In Three Volumes. Price per Vol., $10. Sold either by Volume or in Sets.
Standard text-book for the Engineers and Managers of Gas Works, and for all who are concerned or take an interest in the manufacture and distribution of Coal Gas, and in the utilization of the Secondary Products resulting therefrom; treating also of the Gas Engine and of Gas Cooking and Heating Appliances. A. M. CALLENDER & CO., 32 Pine Street, N. Y. City.

FRED. BREDEL, C. E.,

PROP'R OF KLOENNE AND BREDEL PATENTS.

Recuperative Furnaces, Purifying Machines,

* Gas Apparatus. *

No. 118 Farwell Avenue, Milwaukee, Wis.

GASHOLDER TANKS AND
GAS WORKS MASONRY COMPLETE

Plans prepared and Estimates furnished at short notice.

J. P. WHITTIER,

70 Rush St., Near Division Ave., Brooklyn, N. Y.

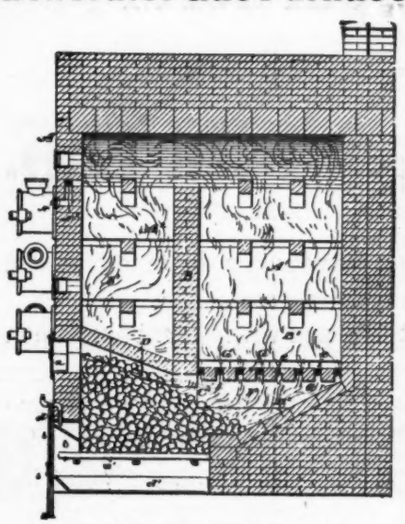
The Gas Engineer's
Laboratory Handbook.

By JOHN HORNBY, F.I.C.

Price, $2.50.

A. M. CALLENDER & CO., 32 Pine Street N. Y. City

FLEMMING'S
Generator-Gas Furnace



Materials furnished and Benches erected by

J. H. GAUTIER & CO., - Jersey City, N. J.

Address as above, or D. D. FLEMMING, Jersey City, N. J.

AMERICAN
GAS LIGHT JOURNAL.

$3.00 per Annum.

A. M. CALLENDER & CO.
32 Pine Street, N. Y

GREENOUGH'S
"DIGEST OF GAS LAW"

Price, $5.00.

This is a valuable and important work, a copy of which should be in the possession of every gas company in the country, whether large or small. As a book of reference it will be found invaluable. It is the only work of the kind which has ever been published in this country, and is most complete. Handsomely bound. Orders may be sent to

A. M. CALLENDER & CO., 32 Pine St., N. Y.

The Miner Street Lamps.

Jacob G. Miner,

No. 823 Eagle Ave., New York, N. Y.

BINDER for the JOURNAL

STRONG.
DURABLE.
LIGHT.
SIMPLE
CHEAP.
HANDSOME.
Price, $1.

A.M. Callende & Co.,
32 Pine st.,
N. Y City

Bartlett Lamp Mfg. Company

MANUFACTURERS OF

Globe Lamps,

FOR

Streets, Parks, Public Buildings, Railroad Stations, etc.

LAMP POSTS

A Specialty.

Office and Salesroom,

137 & 139 W. Broadway, New York City.

Gas Companies and others intending to erect Lamp and Posts will do well to communicate with us.

Parson's Steam Blower,

FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

PARSON'S TAR BURNER.

FOR UTILIZING COAL TAR AS FUEL.

PARSON'S AIR JET TUBE CLEANER,

FOR CLEANING BOILER TUBES.

These devices are all first-class. They will be sent to any responsible party *for trial.* No sale unless satisfactory. Manufactured by the WATERTOWN STEAM BLOWER COMPANY

H. E. PARSON, Supt., 621 Broadway, N. Y

DAVIS & FARNUM MFG. CO.

WALTHAM, MASS.

PRINCIPAL OFFICE AND WORKS, WALTHAM, MASS. BOSTON OFFICE, Room 18, Vulcan Building, 8 Oliver Street.

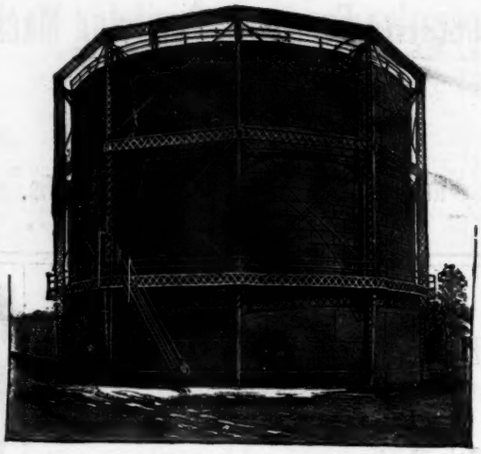
Single, Double and Triple-Lift

Gasholders

of any Capacity.

Steel Tanks for Gasholders.

PURIFYING BOXES, CENTER SEAL OR VALVE CONNECTIONS.



Tubular, Pipe and Sinuous Friction

Condensers

of all Sizes.

Iron Roof Frames and Floors.

BENCH WORK, REVERSIBLE LIME TRAYS.

SELF-SEALING AND PRESSED STEEL MOUTHPIECE LIDS.

Coke Barrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Plant.

— ALSO —

GAS AND WATER PIPE, FLANGED PIPE,

Sugar House Work, and Special Castings of all Description.

INCREASE YOUR PURIFYING CAPACITY

BY THE USE OF THE

"Crighton" Four-Box Center Seal Cap.

Having recently perfected and patented a Five-way Center Seal Cap, we are now in position to offer and recommend it to Gas Companies for increasing their purifying capacity at a moderate cost.

With this Cap you can have **all your Purifying Boxes in constant use,** and where four boxes are in operation at one time, **the capacity is increased one-third.**

Your present Center Seal can be used, and will **only require a new Cap.** Under ordinary circumstances **the change can be made in one day,** and will not necessitate the disturbing of your connections.

Now is the time to make the change, as the work can be done to good advantage during the season of your lightest output.

For information and prices address

KERR MURRAY MFG. CO.,

Manufacturers of Gas Works Apparatus and Holders,

FORT WAYNE, IND.

BARTLETT, HAYWARD & CO.

BALTIMORE, MD.

Triple, Double & Single-Lift

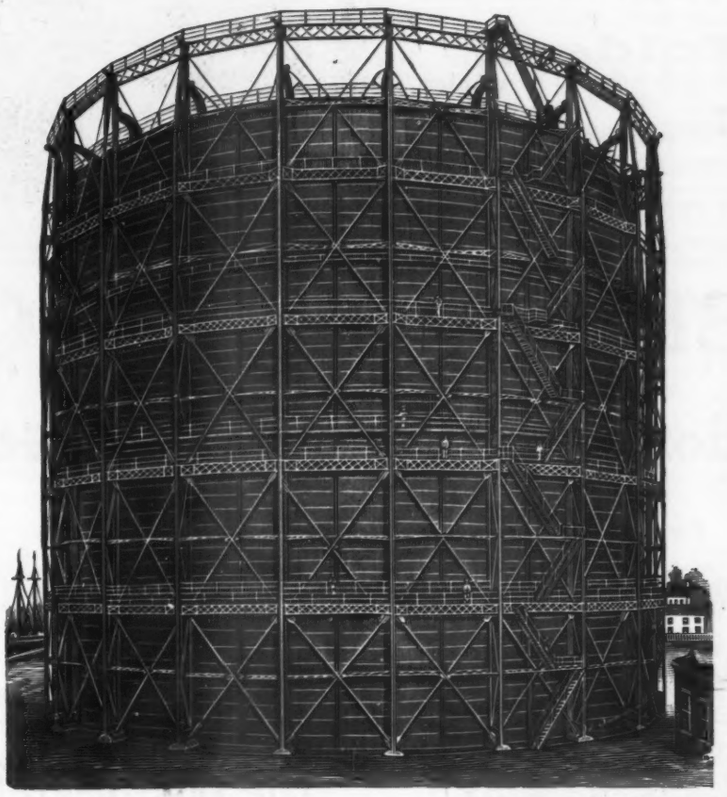
GASHOLDERS.

Iron Holder Tanks.

ROOF FRAMES.

Girders.

BEAMS



PURIFIERS.

CONDENSERS.

Scrubbers.

Bench Castings.

OIL STORAGE TANKS.

Boilers.

Three Four-Lift Gasholders, each of 4,289,500 Cubic Feet Capacity, Erected in Chicago.

The Wilkinson Water Gas Process.

THIRTY-CANDLE, NON-CONDENSABLE, FIXED GAS. THE MOST SUCCESSFUL GAS PROCESS IN OPERATION.

MILL'S REVERSIBLE LIME TRAYS.

Gas Works Designed and Constructed.

FIELD'S ANALYSIS

For the Year 1894.

An Analysis of the Accounts of the Principal Gas Undertakings in England, Scotland, and Ireland. Being the Twenty-fourth Year of Publication. Compiled and Arranged by

JOHN W. FIELD Accountant to the Gas Lt. and Coke Co., London.

Price, $5. For Sale by

A. M. CALLENDER & CO., - No. 32 Pine Street, N. Y. City.

R. D. WOOD & CO., ENGINEERS, IRON FOUNDERS, MACHINISTS.

400 Chestnut Street, Philadelphia, Pa.

MANUFACTURERS OF

CAST IRON PIPE.

BUILDERS OF

Gas Holders,

Single, Double and Triple Lifts, with or without Wrought Iron or Steel Tanks.

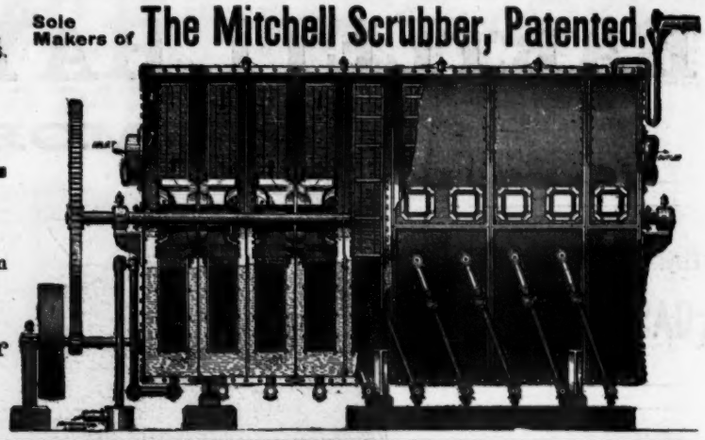
PURIFIERS, CONDENSERS, SCRUBBERS.

The Hopper Automatic Gas Governor

Send for Pamphlet.

Dunham Patent Specials.

Sole Makers of **The Mitchell Scrubber, Patented.**



ISBELL-PORTER CO.,

ENGINEERS AND CONTRACTORS FOR THE

Construction and Extension of Gas Works.

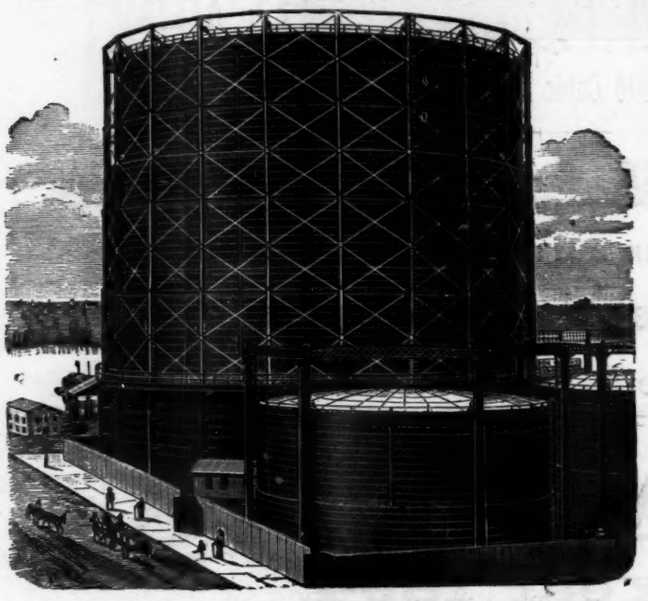
FOUNDERS AND MACHINISTS.

MANUFACTURERS OF

All Ironwork and Machinery Required in a Gas Plant.

Estimates, Drawings and Specifications furnished for the Alteration, Improvement, or Extension of Existing Works or the Construction of New Works.

245 Broadway, New York City. —OFFICES— **Bridge & Ogden Sts., Newark, N. J.**



The Continental Iron Works,

THOMAS F. ROWLAND, President.
WARREN E. HILL and CHAS. H. CORBETT, Vice-Presidents.
THOMAS F. ROWLAND, Jr., Secretary & Treasurer.

BROOKLYN, N. Y.

TAKE EAST TENTH OR TWENTY-THIRD STREET FERRIES FROM N. Y. TO GREENPOINT.

BUILDERS OF

Gas Holders.

Single and Multiple Section Gas Holders a Specialty.

Wrought Iron Gas Holder Tanks.

BENCH CASTINGS, RETORT LIDS.

Hydraulic Mains, Condensers, Scrubbers Purifiers, Valves, Etc.

Self-Sealing Retort Mouthpieces & Lids

For Round, Oval, or "D" Retorts.

ILLUMINATING GAS! FUEL GAS!

THE LOOMIS PROCESS.

Now in successful operation at Works of John Russell Cutlery Co., Turner's Falls, Mass., and Henry Disston's Son's Saw Works, Tacony, Pa.

The Cheapest Gas Generating System in the World.

Plans and Estimates Furnished.

BURDETT LOOMIS, - - Hartford, Conn.

To Gas Companies.

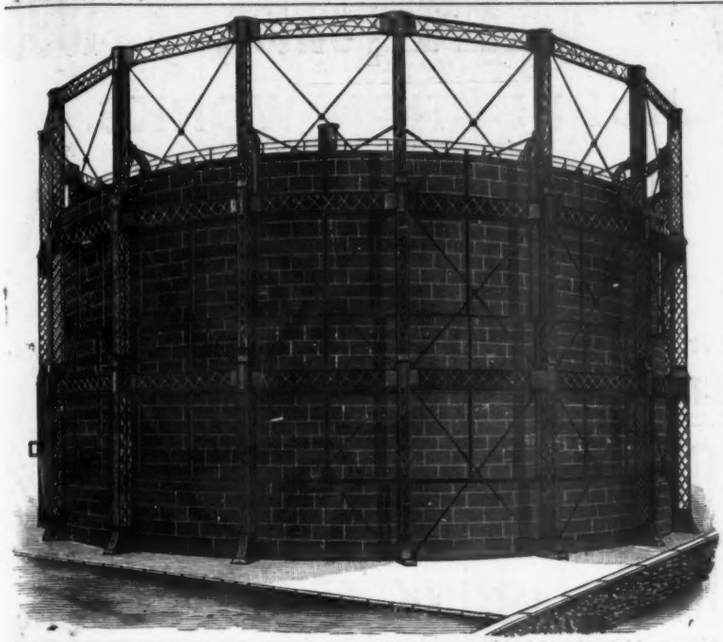
We make to order **CAP BURNERS** to burn any amount under a stated pressure. Send for samples.

Also, SERVICE CLEANERS, DRIP PUMPS, and STREET MAIN PROVING APPARATUS.

C. A. GETRORER,

248 N. 8th St., Phila., Pa.

GAS WORKS APPARATUS AND CONSTRUCTION. GAS WORKS APPARATUS AND CONSTRUCTION.



H. RANSHAW, Prest. & Mangr. T. H. BIRCH, Asst. Mangr
WILLIAM STACEY, Vice-Prest. R. J. TARVIN, Sec. & Treas.

THE STACEY MANUFACTURING CO.
Established 1851.

Single, Double and Triple-Lift

GASHOLDERS,

Of any Capacity, with or without Wrought Iron or Steel Tanks.

Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, etc.

Coal Gas Benches, Roof Frames,

OIL STORAGE TANKS.

Pressed Steel Mouthpiece Lids, Self-Sealing Mouthpiece Lids.

Cincinnati, Ohio.

George Shepard Page's Sons,

Sole Agents for

The "Standard" Washer-Scrubber,

The Walker Tar and Carbonic Acid Extractor, The Walker Sulphate and Ammonia Still,
The Walker Self-Sealing Pressed Steel Mouthpiece Lids.

The Berlin Center Valve. And Contractors for Ammoniacal Liquor.

No. 69 Wall Street, New York City.

GEORGE R. ROWLAND,
Formerly with the Continental Iron Works.
Draughtsman and Constructing Engineer.
Drawings, Specifications and Estimates furnished for the construction of new works or alteration of old works. Special attention given to Patent Office drawings.
Office, No. 245 Broadway, N. Y. City.

H. C. SLANEY,
Gas Engineer
466 Sixth Street, Brooklyn, N. Y.
Plans, Specifications and Estimates furnished for New Works, Alteration or Extension of Old Plants.

T. G. LANSDEN,
Consulting and Contracting Gas Engineer
Estimates, Plans and Specifications for New Works (Coal or Water Gas), and for Extensions or Alterations.
Room H, 108 N. 4th St., St. Louis, Mo.

WM. HENRY WHITE,

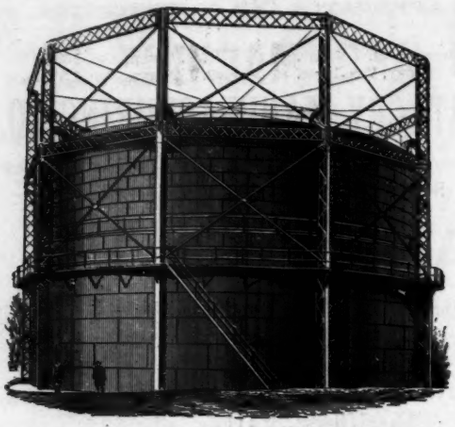
No. 32 Pine Street, - - - New York City.

ENGINEER AND CONTRACTOR FOR THE

ERECTION AND EXTENSION OF

GAS, WATER, AND ELECTRIC LIGHT WORKS.

Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited
Plans and Estimates Furnished.



1842 * Deily & Fowler, * 1895

LAUREL IRON WORKS.

Office, No. 39 Laurel Street, Philadelphia, Pa.

BUILDERS OF

Gasholders

Single or Telescopic. With or Without Iron or Steel Tanks.

OIL TANKS, WATER TANKS, AND GENERAL WROUGHT IRON WORK.

JAMES R. FLOYD & SONS,

Successors to HERRING & FLOYD,
Oregon Iron Works,

West 20th and 21st Streets, Between 10th & 11th Avenues, New York City.

Engineers and Contractors for the Construction of Gas Works.

MANUFACTURERS OF ALL KINDS OF CASTINGS AND GENERAL IRONWORK FOR GAS APPARATUS.

Bench Castings, Regenerative and Half Regenerative Furnace Castings, Condensers, Tower Scrubbers, Mechanical Scrubbers, Purifiers, Malleable Iron Retort Lids, Self-Sealing Retort Lids, Hydraulic Hoist Purifier Carriage, Crosses, Tees, Bends, Angles, Reducers, S-Bends, Sectional Sleeves, Plugs, Caps, Street Drips, etc., always on hand.

WOOD'S GAS SCRUBBING AND ENRICHING APPARATUS.

In use at Syracuse, Auburn, Watertown, Cortland and Geneva, N.Y.; Elizabeth, N. J.; Boston, Mass.; Jamaica Plain, Mass.; Providence, R. I.; Northern Liberties Gas Co., Phila.

Sole Manufacturers of the OGDEN QUICK-MOVING VALVE.

Premium Awarded, World's Columbian Exposition.

HEARNE CENTER SEAL, Operating One, Two, Three or Four Boxes.

INTERESTING TO GAS MANUFACTURERS!

The

Wilke China Kiln.

For Firing Decorated China with Illuminating Gas.

AWARDED THE HIGHEST HONORS, MEDALS AND DIPLOMAS AT THE WORLD'S COLUMBIAN EXPOSITION.

Many Valuable Improvements added to this Kiln in the Last Year.

Not a Toy, but a Practical Kiln.

Has Never Failed to Give Satisfaction.

Guaranteed to fire China successfu ly, and without any discoloration from fuel used.

Thousands in use, and not a single failure.

Full directions furnished with each Kiln sold by which any amateur can fire it without any previous knowledge of this branch of the work. Send for descriptive circular. Address

F. A. WILKE,
Richmond, Ind.

Water, Gas and Culvert Pipe, Cranes, Road Rollers, Special Machinery

FROM

Manufacturer's Designs

For special information and prices, write to

The Addyston Pipe & Steel Co., Cincinnati, O.

The Gas Engineer's Laboratory Handbook.

BY JOHN HORNBY, F.I.C. Price, $2.50.

A. M. CALLENDER & CO., - - No. 32 Pine Street, New York City.

JOS. R. THOMAS,

No. 32 Pine Street, N.Y. City.

CONSULTING AND CONSTRUCTING

Gas Engineer and Contractor.

PLANS, SPECIFICATIONS AND ESTIMATES FURNISHED.

Contracts taken for all Appliances required at a Gas Works,

Either for New Works or Extensions to Old Plants

GAS AND WATER PIPES.

THE OHIO PIPE COMPANY,

MANUFACTURERS OF

Cast Iron Gas & Water Pipe,

BRANCH AND SPECIAL CASTINGS.

Gas-House Bench Castings, Hydraulics, Lamp Posts, Flange Pipe and Specials, Architectural Castings, Building Columns, Joists, Cellar Grates, Sash Weights, etc.

GENERAL FOUNDERS AND MACHINISTS

Columbus, Ohio.

Management of Small Gas Works.

By C. J. R. HUMPHREYS. Price, $1.

A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY

The Chemistry of Illuminating Gas.

By NORTON H. HUMPHRYS. Price, $2.40.

A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY.

GAS METERS.

WARREN FOUNDRY AND MACHINE CO.,

Established 1856. Works at Phillipsburgh, N. J.

New York Office, 160 Broadway.

CAST IRON WATER AND GAS PIPE,

FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc

---

M. J. DRUMMOND,

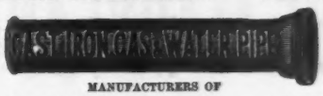
SPECIAL CASTINGS AND LAMP POSTS.

Office, Corbin Building, 192 Broadway, N. Y.

GEORGE ORMROD, Mangr. & Treas., Emaus, Pa.
JOHN DONALDSON, Prest., Betz Bldg., Phila., Pa

EMAUS PIPE FOUNDRY.

DONALDSON IRON COMPANY. EMAUS, PA



MANUFACTURERS OF

CAST IRON PIPE AND SPECIAL CASTINGS

FOR WATER AND GAS.

Also, FLANGE PIPE, LAMP POSTS, Etc.

1894 DIRECTORY 1894

OF AMERICAN GAS COMPANIES

Price, - - - - - - - - - $5.00.

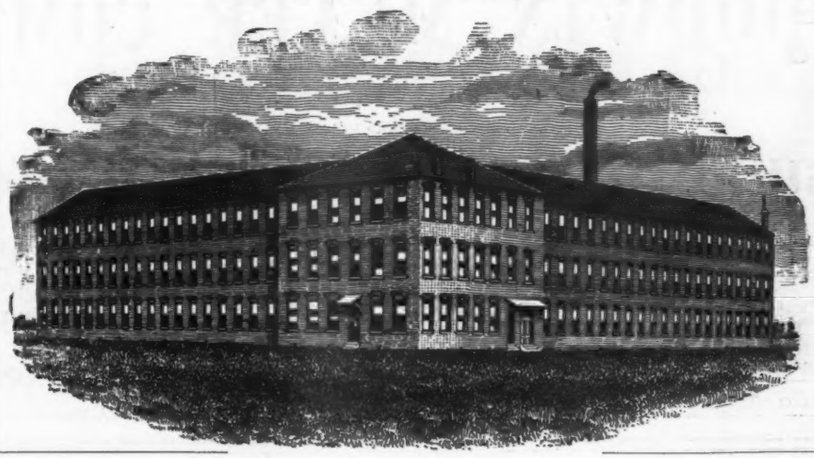
A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.

N. Y. AGENCY,

Bartlett Lamp Mfg. Co.,

39 & 41 W. Broadway,
New York City.

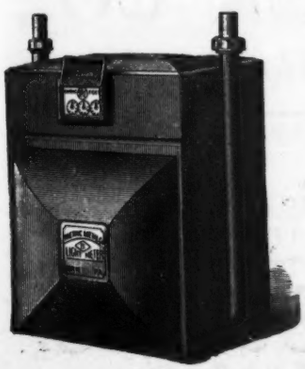
Telephone, 1125 Courtlandt.



Factory and Office

ERIE, PA.

ESTIMATES FURNISHED ON APPLICATION.



METRIC METAL CO.,

MANUFACTURERS OF

Dry Gas Meters

FOR ALL KINDS OF SERVICE

Special Attention Paid to
REPAIRING METERS OF ALL MAKES.

Agts., McELWAINE-RICHARDS CO., 62 & 64 W. Maryland St., Indianapolis, Ind

Established 1849. With the best facilities for manufacturing, is enabled to furnish reliable work and answer orders promptly.

NATHANIEL TUFTS,

153 Franklin St., Boston, Mass.

C. W. HINMAN, - - Manager.

MANUFACTURER OF

DRY GAS METERS.

Station Meters of any Capacity.

Test and Experimental Meters, Pressure Registers, Pressure Gauges.

METER PROVERS, PHOTOMETERS, STREET LANTERNS, ETC., ETC.

Apparatus for the Chemical Testing of Gas and Gas Liquor.

CHARLES E. DICKEY. JAMES B. SMALLWOOD. CHARLES H. DICKEY.

THE MARYLAND METER AND MANUFACTURING CO.

Established 1866.

BALTIMORE, North & Saratoga Sts. **CHICAGO, 122 & 124 Michigan St.**
NEW YORK, 838 Broadway. **SAN FRANCISCO, 221 Front St.**
BOSTON, 92 Water Street, Rooms 21 and 22.

CONSUMERS' & STATION METERS, PRESSURE GAUGES, Etc., Etc.

"Success" and "Perfect" Gas Stoves.

THE GOODWIN METER COMPANY,

1012-1018 Filbert Street, Philadelphia, Pa.

MANUFACTURERS OF

Consumers' and Station Meters,

Standard Photometrical and Analytical Gas Apparatus

"SUN DIAL" GAS COOKING AND HEATING STOVES.

Particular attention given to Repairing Meters and Scientific Apparatus. . . .

GEORGE B. EDWARDS, Agent,
113 Chambers Street, N. Y. City.

THE KEYSTONE METER CO.,

Factory and Office, ROYERSFORD, PA.

WESTERN MANAGERS:
CAHILL, SWIFT & CO.,
121-207 South Seventh Street,
ST. LOUIS, MO.

PACIFIC:
WIESTER & CO.,
15 & 17 New Montgomery St.,
SAN FRANCISCO, CAL.

Gas Meters and Gas Stoves.

GAS METERS. GAS METERS. GAS METERS.

WM. N. MILSTED, Prest. and Genl. Supt. WM. H. HOPPER, Vice-Prest. PAUL S. MERRIFIELD, Sec. and Treas.

THE AMERICAN METER CO.

Established 1834. Incorporated 1863.

WET AND DRY GAS METERS. PRESSURE REGISTERS. METER PROVERS.
STATION METERS. PRESSURE & VACUUM REGISTERS. PORTABLE TEST METERS.
EXHAUSTER GOVERNORS. PRESSURE & VACUUM GAUGES. EXPERIMENTAL METERS.
DRY CENTER VALVES. CRESSON GAS REGULATORS. AMMONIA TEST METERS.
GOVERNORS FOR GAS WORKS. MARSLAND WATER METERS. BAR & JET PHOTOMETERS.

Manufactories:
512 West 22d St., N. Y.
Arch & 22d Sts., Phila.

GAS STOVES.
SUGG'S "STANDARD" ARGAND BURNERS,
SUGG'S ILLUMINATING POWER METER,
Wet Meters, with Lizar's "Invariable Measuring" Drum.

Agencies:
125 & 127 S. Clinton Street, Chicago.
810 North Second Street, St. Louis.
222 Sutter Street, San Francisco.

HELME & McILHENNY,

(Established 1848.)

Gas Meter Manufacturers

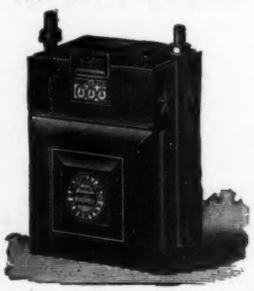
1339 to 1349 Cherry Street, Philadelphia, Pa.

Wet and Dry Gas Meters, Station Meters, Experimental Meters, Meter Provers, Center Seals, Pressure Registers, Governors, Indicators, Photometers

AND ALL OTHER KINDS OF APPARATUS FOR USE IN GAS WORKS.

FOULIS' PATENT STATION AND DISTRICT GOVERNORS.

REPAIRING DEPARTMENT.—We employ a special force of skilled workmen repairing meters of ALL MAKERS.



D. McDONALD & CO.,

Established 1854.

154 West 27th Street, NEW YORK CITY.
51, 53 & 55 Lancaster St., ALBANY, N. Y.
34 & 36 W. Monroe St., CHICAGO, ILL.

MANUFACTURERS OF

Wet and Dry Gas Meters

STATION METERS, EXPERIMENTAL METERS, METER PROVERS, PRESSURE & VACUUM REGISTERS & PRESSURE GAUGES.

Meters of all makers Thoroughly Repaired.

W. H. PEARSON, President. J. T. WESTCOTT, Gen'l Mang'r & Treas. L. L. MERRIFIELD, Chief Engineer.

The Economical Gas Apparatus Construction Co., Ld.

269 Front Street, East, - - Toronto, Canada.

ENGINEERS AND BUILDERS

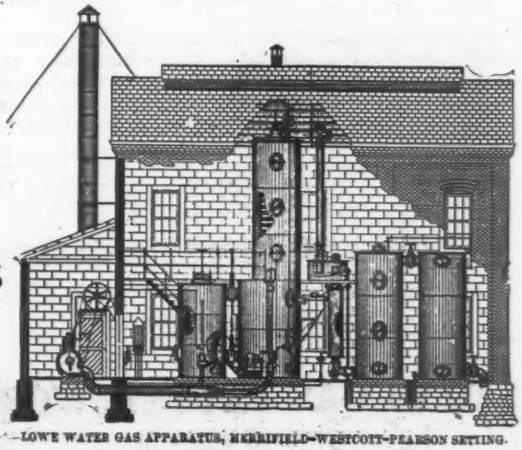
OF THE

Improved Lowe Water Gas Apparatus

Designed to give the Greatest Efficiency when using any kind of Oil, Anthracite Coal, Gas House or Oven Coke.

New Gas Works Built, Present Gas Plants, either Coal or Water, Remodeled

Catalogues, Plans and Estimates Furnished upon Application.



LOWE WATER GAS APPARATUS, MERRIFIELD-WESTCOTT-PEARSON SETTING.

The advertisement of

JOHN J. GRIFFIN & CO., Mfrs. of Gas Meters, etc.,

Nos. 1513, 1515, 1517, 1519 & 1521 Race Street, Philadelphia,
52 Dey Street, New York, 75 N. Clinton Street, Chicago,

Occupies this page every alternate week

UNEQUALED

For efficiency and low gas consumption.
For smooth and quiet running.
For simplicity of construction and grace in design.
For general reliability.
For close regulation of power.

150 MEDALS AND DIPLOMAS.

The "OTTO"--The First.

The First to use the four-stroke cycle. **The First** to admit well measured and distinct charges of gas into an air space. **The First** in the adoption of poppet valves. **The First** to develop the tube igniter, with automatic or timed firing. **The First** to have a reliable electric and a practical magnectic igniter.

THE FIRST SMOOTH RUNNING & NOISELESS GAS ENGINE COMBINING EFFICIENCY & SIMPLICITY.

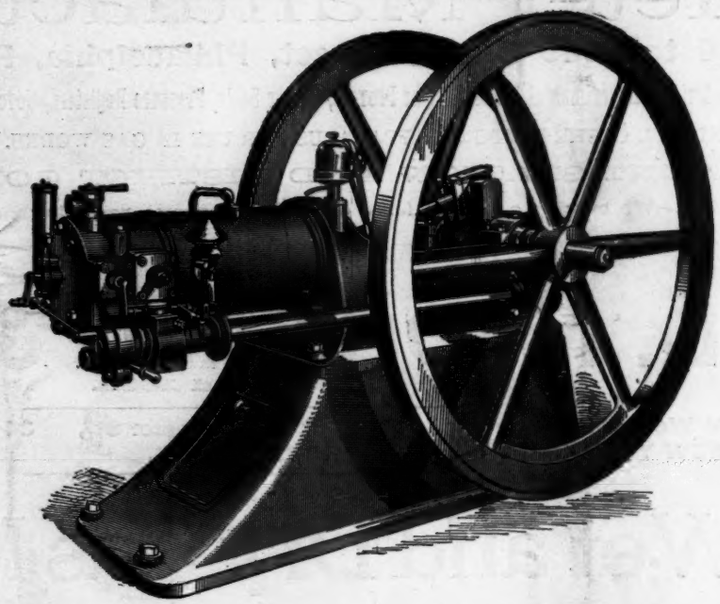
Our Columbian Style

IS FITTED

With removable seats and casings for all valves.

With Patent Alloy Tube, good for one year.

With timing device for ignition, preventing starting backward; or with electric igniter.



SIMPLICITY, as far as is possible, with good design and perfect Working. Built on scientific principles, with a view to **HIGHEST EFFICIENCY**

Sizes,
1-3d to 120 H.P.

The First and Only Engine To-day to Please Every Purchaser.

DEMONSTRATION

It is almost a quarter of a century since the "Otto" revolutionized old and bad practices by introducing principles of combustion "entirely new" in the construction of Gas Motors.

A quarter of a century of uninterrupted success has demonstrated the correctness of these principles.

The gas engine history of the past proves that all competitors have recognized this fact by becoming imitators.

Since its advent the "Otto" engine has been illustrating mechanical improvement without alteration, while others have been offering alterations as improvements.

The experience of the past shows that it requires years to determine the real merits of a gas engine, and that nearly all new gas engines prove failures. **The fittest survive, and the only safe thing to do** in selecting a gas engine is to buy what the tests of practical use, through a long period of time, have proven to be the best.

The Practical Tests of a Quarter of a Century have Demonstrated that the "OTTO" Stands To-day Unrivaled

For simplicity of construction and grace in design; for general reliability and ease of management; for quiet and smooth running qualities; for efficiency and low gas consumption; for regularity of speed and close regulation of power.

"OTTO GAS ENGINE WORKS," 33d & Walnut Streets, Phila., Pa.

NEW YORK 18 Vesey St BOSTON, 19 Pearl St. CHICAGO, 245 Lake St